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MATHEMATICS
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BY
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AND
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BOOK TWO

AUTHORIZED BY THE MINISTERS OF EDUCATION
IN ALBERTA, MANITOBA AND SASKATCHEWAN

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INTRODUCTION

This book contains an enriched and vitalized treatment of mathematics for Grade Eight.

The simple, well-integrated treatment of algebra, geometry, trigonometry, and arithmetic which this series affords contributes effectively to the development in the pupils of an appreciation of the function of number as a tool for thinking, or a method of thinking. The mathematics presented is that of the community and of the daily life of the pupil. This rich socialized material insures sustained interest.

The provision that has been made for individual differences is one of the outstanding features of this series. The following specific points may be listed:

1. Survey tests for each process to enable the teacher, at the beginning of the year, to get a general picture of the ability of the pupils in the various fundamental arithmetic processes.

2. Comprehensive diagnostic tests in the various processes to enable the teacher to locate specific weaknesses in the process. These tests are similar to the well-known Brueckner Diagnostic Tests in the several processes.

3. In a very skilful way these comprehensive diagnostic tests are woven into an effective remedial and practice programme.

4. Special pupil helps on difficult points in the various processes are provided for pupil reference. This plan insures the possibility of the pupil himself working directly on the problem of eliminating his difficulties with a minimum of teacher attention.

5. In order to insure maintenance of the acquired skills throughout the year, periodic standardized practice tests are provided. The standards for these drills are reasonable speed

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and 100-per-cent accuracy. The time limits are liberal and include time needed for checking all work. A premium is placed on accurate work.

6. Problem scales and helps in problem solving enable the teacher to locate pupils deficient in problem solving and contain the basis of a sound remedial program in problem solving.

7. Starred problems, topics for special reports, suggested investigations, and many devices for maintaining a sustained interest on the part of pupils of superior ability are a distinct contribution to the pedagogy of mathematics. These materials may be used at the option of the teacher who will assign the work according to the abilities and interests of the class.

8. The carefully graded steps in teaching and the wealth of practice exercises tend to insure mastery.

9. Systematic review exercises at the close of each chapter give accurate information to the teacher and to the pupils.

Teachers should adjust the amount of work covered by a class to the ability of the class. There is enough material provided for the superior class. Starred problems, and in some cases whole sets of problems, may be omitted in the case of slow classes without interfering with the major sequence of the book. It is not expected that every class will cover the entire body of material.

ACKNOWLEDGMENTS

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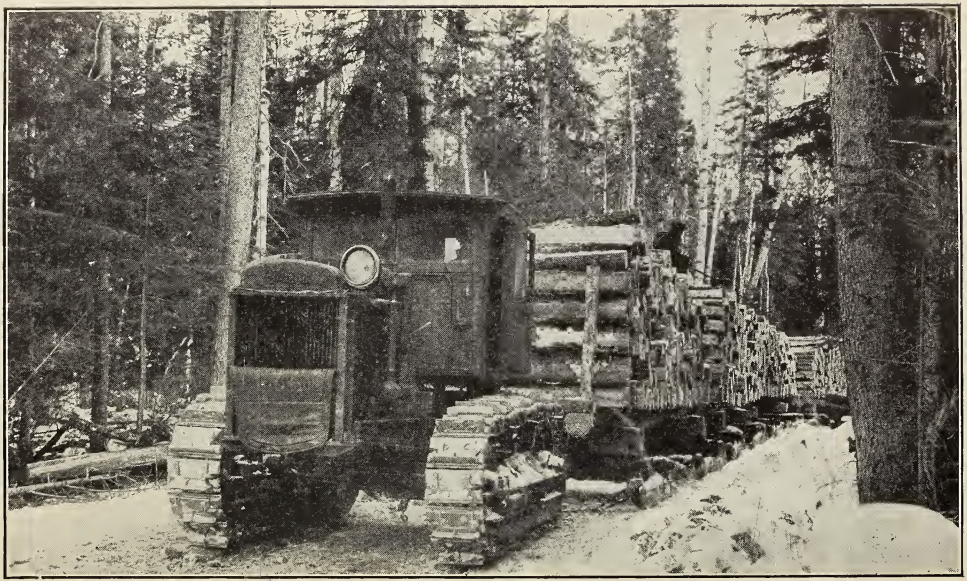


Canada—the land of great forests. Lumber and its products are second only to wheat as the chief export.

SECTION I

USING A TIME-TABLE

Use the time-table to find the answers to the questions below.

Read Down		TABLE 268	Read Up
No. 7	Miles		No. 8
P. M.			A. M.
11.55	0.0	.... Regina	6.20
6.40 Ar. / 9.10 Lv.	161.9	.. Saskatoon ..	Lv. 11.57 / Ar. 8.30
9.35	175.5	... Warman ...	8.05
9.45	179.4	..... Osler	7.57
10.09	190.6	.... Hague	7.38
10.34	201.7	...Rosthern ...	7.11
10.58	213.2	.. Duck Lake ..	6.46
11.32	230.4	.. Macdowall ..	6.11
12.15	249.0	.Prince Albert.	5.30
P. M.			P. M.

1. What is the number of the time-table? What is the number of the train travelling from Regina to Prince Albert? from Prince Albert to Regina?

2. How many miles is it from Regina to Saskatoon? from Saskatoon to Prince Albert?

3. How long does it take train No. 7 to go from Regina to Saskatoon? from Saskatoon to Prince Albert?

4. How long does it take train No. 8 to go from Prince Albert to Saskatoon? from Saskatoon to Regina?

5. Find the average number of miles an hour train No. 8 travels between Prince Albert and Saskatoon.

6. Standard fare in most of Canada is 3.45 cents a mile. At that rate what is the fare for a trip of 15 miles?

7. At the rate of 3.45 cents a mile, how much would be the fare from Regina to Saskatoon?

8. At the rate of 3.45 cents a mile, find the fare from Warman to Rosthern; from Duck Lake to Prince Albert.

Train by night and airplane by day is now quite a common way of travelling.

9. In western Canada beyond Edson, Alberta, the fare is 4.0 cents a mile. From Edson to Jasper, near one of Canada's finest parks, the distance is 106.2 miles. Find the fare at the rate of 4.0 cents a mile.

10. From Jasper to Vancouver the distance is 534.9 miles. Find the fare at the rate of 4.0 cents a mile.

***11.** Get a time-table and find the distance from your home to some important city, the time of departure, and return, and the time required to make the trip. Compute the fare at the rates given in problems **6** and **9**, using the correct rates.

***12.** Railroads often give reduced rates for round-trip tickets, week-end trips and excursions. Find out about the difference between regular and reduced rates. Why are excursion fares usually lower than the regular fares?

TESTS IN THE FUNDAMENTALS

You should be able to find the answers for each of the following sets of examples and to check your work in the time allowed. In addition and subtraction write the answers on paper placed beneath each row of examples.

ADDITION (5 minutes)

1.	2.	3.	4.	5.	6.
684	235	693	849	331	996
336	250	164	607	349	811
956	792	845	942	285	982
742	877	452	358	466	513
493	978	749	516	588	241
536	769	789	799	417	918

SUBTRACTION (2 minutes)

1.	2.	3.	4.
9,317	9,361	7,493	8,802
4,432	4,327	2,638	1,326
5.	**6.**	**7.**	**8.**
8,921	9,727	9,322	8,362
5,896	2,039	3,345	1,799
9.	**10.**	**11.**	**12.**
8,431	5,244	8,510	7,456
4,988	2,579	5,889	4,679

MULTIPLICATION (6 minutes after copying)

1.	2.	3.	4.	5.	6.
395	269	179	735	417	281
74	28	93	56	704	65
7.	**8.**	**9.**	**10.**	**11.**	**12.**
147	268	268	853	946	534
82	39	47	208	506	309

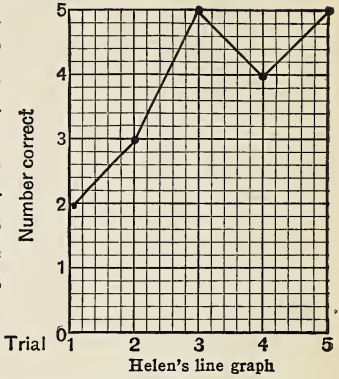
DIVISION (6 minutes after copying)

1. $46\overline{)16,422}$ **2.** $85\overline{)27,115}$ **3.** $39\overline{)28,509}$ **4.** $64\overline{)60,224}$

5. $27\overline{)10,395}$ **6.** $58\overline{)15,892}$ **7.** $98\overline{)49,784}$ **8.** $85\overline{)81,260}$

GRAPHING YOUR TEST SCORES

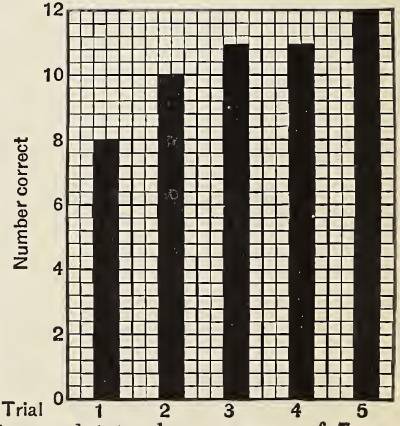
A progress chart is an excellent device to use to show your improvement on the practice work which you are doing.



Helen's line graph

1. The line graph at the right, drawn on cross-section paper, shows Helen's scores on five trials of the addition test, page 3. What was her score on each trial? Need Helen continue to practise this test?

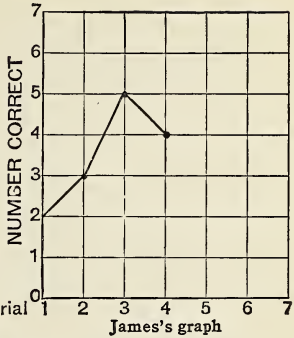
2. Harry uses a bar graph, like the one at the right, to show his progress on the subtraction test, page 3. What were his scores on the five trials? Should Harry continue to practise this test?



3. James made a graph on plain paper similar to the one shown on page 5. He drew cross lines and vertical lines to help him to locate the score which he made on each trial. Where would he place a dot to show a score of 7 examples correct on the fifth trial of the test?

4. Draw a chart similar to the one which James drew. On your chart show the following scores in five trials of a test:

Trial	1	2	3	4	5
Number Correct	5	7	8	7	10



James's graph

5. Show your progress in one of the tests in whole numbers or fractions by a graph similar to one of those given on pages 4 and 5.

***6.** Draw a chart similar to the one which James drew but do not draw the cross or vertical lines. On this chart try to locate the scores given for each trial in problem **4**. What difficulties do you encounter in trying to locate the points to be used in constructing the graph?

Frequency Graphs or Histograms

Miss James prepared a table of the scores made by the pupils in a seventh-grade mathematics class in the multiplication test, page 3. This table, shown at the right, is called a *frequency* table. It shows how often each score was made.

Number Correct	Frequency
12	8
11	7
10	7
9	4
8	5
7	3
6	4
5	2
4	1
3	0
2	0
1	0

1. How many pupils had 12 examples correct?. How many had 11 correct? How many had 3 correct?

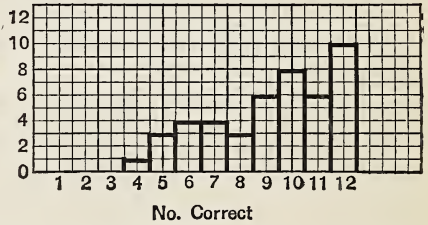
2. How many pupils were there in the class?

3. A frequency table is a convenient, systematic method of arranging a number of items. Make a frequency table of the following scores: 8, 9, 7, 12, 5, 11, 6, 8, 9, 6, 12, 10, 7, 8, 5, 4, 12, 10, 11, 9, 6, 11, 12, 7, 8, 5, 6, 9.

4. Find the average score made by the pupils in problem **3.**

5. Make a frequency table of the scores made by the members of your class in one of the tests on page 3.

The facts in a frequency table may also be shown by a *frequency graph* or *histogram* such as the one at the right. This graph is composed of a series of rectangular bar graphs.

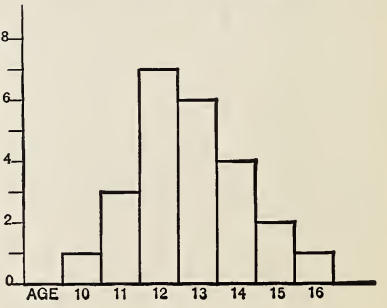


6. How many had 12 correct? 11 correct? 10 correct?

7. Make a frequency graph of the facts in problem **3.**

***8.** Make a frequency graph showing the scores by the members of your class in one of the tests on page 3.

***9.** At the right is a histogram showing the number (frequency) of pupils of each age in a seventh-grade class. From the graph make a frequency table showing the ages of pupils and their frequency.



PRACTICE TESTS IN THE FUNDAMENTALS

You should be able find the answers to these addition examples and check your work in *eight minutes:*

1.	2.	3.	4.	5.	6.
767	398	599	759	268	721
179	399	829	117	244	533
788	854	385	439	106	700
865	256	314	987	491	693
786	475	812	292	130	800
244	403	555	724	648	969
602	731	368	656	726	601

You should be able to find the answers to these subtraction examples and check your work in *two minutes:*

1.	3.	5.	7.
135,763	160,804	127,678	104,768
84,957	91,813	89,732	35,419
2.	**4.**	**6.**	**8.**
87,452	85,763	115,590	146,792
35,983	27,485	37,954	66,845

You should be able to find the product of these multiplication examples and check your work in *five minutes:*

1.	3.	5.	7.
5,617	5,248	5,074	3,758
74	39	85	62
2.	**4.**	**6.**	**8.**
3,769	6,389	8,249	1,964
93	58	407	260

Find the quotients and check your work in *fifteen minutes:*

1. 183,923 ÷ 349 =
2. 895,408 ÷ 178 =
3. 319,957 ÷ 493 =
4. 225,128 ÷ 526 =
5. 142,040 ÷ 265 =
6. 268,632 ÷ 328 =

SURVEY TESTS IN FRACTIONS

Addition. You should be able to work all of these examples correctly in less than *six minutes*.

1. $\frac{1}{5}$	**3.** $1\frac{1}{4}$	**5.** $\frac{1}{5}$	**7.** $2\frac{3}{4}$	**9.** $1\frac{1}{8}$	**11.** $\frac{5}{8}$
$\frac{1}{5}$	$1\frac{1}{4}$	$\frac{1}{4}$	4	$1\frac{1}{4}$	$\frac{5}{6}$
	$2\frac{1}{2}$	$\frac{1}{4}$		$3\frac{3}{8}$	
2. $\frac{1}{2}$	**4.** $1\frac{1}{8}$	**6.** $1\frac{3}{6}$	**8.** $7\frac{1}{4}$	**10.** $\frac{1}{10}$	**12.** $2\frac{1}{8}$
$\frac{1}{2}$	$3\frac{3}{8}$	$7\frac{2}{5}$	$2\frac{1}{4}$	$\frac{1}{10}$	$7\frac{3}{8}$
	$2\frac{1}{2}$			$1\frac{1}{5}$	

Subtraction. You should be able to work all of these examples correctly in less than *six minutes*.

1. $\frac{3}{4}$	**3.** $7\frac{5}{6}$	**5.** $10\frac{1}{3}$	**7.** $4\frac{5}{9}$	**9.** $4\frac{2}{8}$	**11.** $7\frac{1}{8}$
$\frac{1}{4}$	$\frac{1}{6}$	$3\frac{2}{3}$	$\frac{1}{9}$	$\frac{4}{6}$	$\frac{5}{8}$
2. $5\frac{1}{4}$	**4.** $7\frac{3}{5}$	**6.** 8	**8.** $\frac{5}{8}$	**10.** 5	**12.** $7\frac{1}{5}$
3	$1\frac{1}{10}$	$3\frac{3}{8}$	$\frac{1}{8}$	$\frac{2}{3}$	$3\frac{3}{8}$

Multiplication. You should be able to work all of these examples correctly in less than *six minutes*.

1. $4 \times \frac{1}{2} =$	**5.** $\frac{3}{9} \times 2 =$	**9.** $3\frac{4}{5} \times 3\frac{1}{3} =$
2. $\frac{5}{6} \times \frac{3}{10} =$	**6.** $3\frac{1}{6} \times 4 =$	**10.** $\frac{4}{5} \times \frac{1}{2} =$
3. $\frac{5}{8} \times 6\frac{4}{5} =$	**7.** $3 \times \frac{1}{6} =$	**11.** $9\frac{1}{2} \times \frac{2}{9} \times 1\frac{1}{8} =$
4. $2 \times \frac{4}{9} =$	**8.** $\frac{2}{3} \times 16 =$	**12.** $8\frac{3}{4} \times \frac{3}{5} \times 2\frac{2}{9} =$

Division. You should be able to work all of these examples correctly in less than *six minutes*.

1. $\frac{1}{2} \div \frac{1}{2} =$	**5.** $\frac{3}{8} \div 1\frac{2}{3} =$	**9.** $7\frac{1}{2} \div 5 =$
2. $1\frac{3}{8} \div 1\frac{2}{3} =$	**6.** $12 \div 5\frac{2}{5} =$	**10.** $3 \div 4\frac{1}{2} =$
3. $\frac{5}{6} \div \frac{3}{10} =$	**7.** $12 \div \frac{3}{4} =$	**11.** $3\frac{1}{3} \div 1\frac{3}{4} =$
4. $2 \div 2\frac{1}{2} =$	**8.** $2\frac{3}{4} \div 4\frac{2}{5} =$	**12.** $3\frac{1}{3} \div 10 =$

If you make any mistakes in any of these tests, practise the examples in this process on the following pages.

CHANGING THE FORM OF FRACTIONS

1. Reduce the following fractions to lowest terms:

a. $\frac{16}{32}$ *b.* $\frac{15}{21}$ *c.* $\frac{9}{36}$ *d.* $\frac{120}{150}$ *e.* $\frac{36}{72}$ *f.* $\frac{42}{112}$

2. Supply the missing terms in each of the following:

a. $\frac{1}{3} = \frac{}{6} = \frac{}{9} = \frac{}{15} = \frac{}{12} = \frac{}{27}$ *b.* $\frac{1}{2} = \frac{}{48}$

c. $\frac{7}{8} = \frac{}{16}$ *d.* $\frac{4}{5} = \frac{}{20}$ *e.* $\frac{2}{3} = \frac{}{12}$ *f.* $\frac{3}{4} = \frac{}{20}$

3. Change the following improper fractions to whole or mixed numbers. Express all answers in lowest terms.

a. $\frac{8}{6} =$ *b.* $\frac{15}{10} =$ *c.* $\frac{12}{4} =$ *d.* $\frac{19}{12} =$ *e.* $\frac{35}{15} =$

4. Change the following mixed numbers to improper fractions:

a. $1\frac{1}{3}$ *b.* $2\frac{1}{4}$ *c.* $7\frac{2}{3}$ *d.* $5\frac{3}{5}$ *e.* $6\frac{3}{8}$ *f.* $7\frac{3}{10}$

5. Change these pairs of unlike fractions to fractions with a lowest common denominator. The first example is worked correctly.

a. $\frac{1}{2} = \frac{2}{4}$ *b.* $\frac{5}{8} =$ *c.* $\frac{2}{3} =$ *d.* $\frac{1}{8} =$ *e.* $\frac{2}{3} =$ *f.* $\frac{1}{6} =$

$\frac{1}{4} = \frac{1}{4}$ $\frac{1}{4} =$ $\frac{3}{5} =$ $\frac{5}{6} =$ $\frac{3}{4} =$ $\frac{1}{4} =$

6. Change $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{8}$ to 24ths.

7. Change $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{8}$ to fractions having a lowest common denominator.

8. Supply the missing numerators in the following:

a. $5\frac{1}{4} = 4\frac{}{4}$ *b.* $2\frac{1}{2} = 1\frac{}{2}$ *c.* $6\frac{2}{3} = 5\frac{}{3}$ *d.* $7\frac{1}{4} = 6\frac{}{8}$

e. $4 = 3\frac{}{4}$ *f.* $9\frac{5}{8} = 8\frac{}{24}$ *g.* $9 = 8\frac{}{6}$ *h.* $7\frac{5}{6} = 6\frac{}{18}$

9. Reduce the following to simplest form:

a. $6\frac{11}{5} =$ *b.* $8\frac{3}{3} =$ *c.* $15\frac{12}{8} =$ *d.* $9\frac{8}{4} =$

10. Express the following as fractional parts of 100:

a. 25 *b.* 50 *c.* 75 *d.* $12\frac{1}{2}$ *e.* $37\frac{1}{2}$

f. $62\frac{1}{2}$ *g.* $87\frac{1}{2}$ *h.* $33\frac{1}{3}$ *i.* $66\frac{2}{3}$ *j.* 20

k. 40 *l.* 60 *m.* 80 *n.* $83\frac{1}{3}$ *o.* $16\frac{2}{3}$

USING FRACTIONS IN BUYING AT A STORE

Fractions are used very frequently in finding the cost of articles bought at a store. In order to be sure that you are paying the correct amount for your purchases you must be able to compute correctly with fractions.

1. Martha bought $2\frac{1}{2}$ yards of blue ribbon and $1\frac{1}{4}$ yards of red ribbon. How much did the ribbon cost at \$.40 a yard?

2. Alice wished to buy enough cloth for 6 pennants. She needs 30 inches of cloth for each. How much does the cloth cost at \$.36 a yard?

3. How much do 18 bananas cost at \$.28 a dozen?

4. Arthur paid \$.27 for a half pound of butter. At that rate how much do 2 pounds of butter cost?

5. Mary saw a remnant of cloth $5\frac{3}{4}$ yards long. The clerk cut off a piece $2\frac{3}{4}$ yards long. How much does the remaining part of the remnant cost at \$.27 a yard?

6. At a "$\frac{1}{3}$-off" sale Grace bought a toilet set, originally priced at \$2.40. Grace objected when the clerk asked \$1.80 for the set. Grace said that the correct amount was \$1.60. Who was correct?

7. Margaret paid \$1.60 for a tennis racket at the same sale. What was the regular price of the racket?

8. Julia paid \$.25 for $7\frac{1}{2}$ pounds of potatoes. If she had bought a 60-pound basket of potatoes for \$1.20, how much would she have saved on each $7\frac{1}{2}$ pounds?

9. Find the cost of 18 inches of lace at \$1.20 a yard.

10. Mabel paid 15 cents for 3 eggs. At this rate how much did eggs cost a dozen?

11. At 3 for 5 cents, how much do a dozen apples cost?

12. Graham crackers cost \$.20 a pound in bulk and \$.25 a pound in package. What fraction of the bulk cost a pound is saved by buying in bulk instead of by the package?

13. How many pounds of cookies can you buy for \$1.50 at $37\frac{1}{2}$ cents a pound?

14. At \$.74 for 10 pounds, how much do 5 pounds of sugar cost? 20 pounds? 100 pounds? 4 pounds?

15. Butter costs \$.54 a pound package and \$.29 a half-pound package. How much do you save by buying 10 pounds of butter in pound packages?

16. At \$.56 a pound, how much do 14 ounces of cheese cost? 1 pound 4 ounces? 1 pound 8 ounces? 1 pound 10 ounces? 1 pound 11 ounces?

17. At \$1.40 a hundred pounds, how much do 150 pounds of hay cost? 175 pounds?

18. Mr. Miller bought a dining-room table at a reduction of $33\frac{1}{3}\%$. If the regular price of the table was \$45, how much did he pay for the table?

FINDING HARD SPOTS IN ADDITION

Work these examples carefully. Be sure to express the answers in simplest form. Check your work at each step.

Set I (5 minutes)

	a	*b*	*c*	*d*	*e*
1.	$\frac{1}{5}$ $\frac{1}{5}$	$\frac{5}{8}$ $\frac{1}{8}$	$\frac{1}{4}$ $\frac{3}{4}$	$\frac{4}{5}$ $\frac{3}{5}$	$\frac{5}{8}$ $\frac{7}{8}$
2.	6 $\frac{1}{4}$	$\frac{2}{3}$ 7	5 $1\frac{3}{4}$	$7\frac{1}{8}$ 6	$2\frac{1}{4}$ $\frac{1}{4}$ 4
3.	$4\frac{2}{5}$ $\frac{1}{5}$	$\frac{1}{6}$ $3\frac{1}{6}$	$4\frac{2}{3}$ $7\frac{1}{3}$	$3\frac{2}{3}$ $6\frac{2}{3}$	$9\frac{5}{6}$ $8\frac{5}{6}$

Set II (5 minutes)

1.	$\frac{1}{2}$ $\frac{1}{4}$	$\frac{1}{2}$ $\frac{1}{6}$ $\frac{1}{2}$	$\frac{1}{3}$ $\frac{1}{6}$ $\frac{2}{3}$	$\frac{1}{3}$ $\frac{1}{6}$	$\frac{7}{12}$ $\frac{3}{4}$
2.	$3\frac{2}{3}$ $\frac{1}{6}$	$4\frac{1}{4}$ $5\frac{7}{12}$	$4\frac{1}{4}$ $\frac{1}{2}$ $3\frac{1}{4}$	$7\frac{3}{4}$ $3\frac{1}{8}$ $4\frac{3}{8}$	$2\frac{1}{3}$ $1\frac{1}{3}$ $7\frac{5}{6}$
3.	$\frac{1}{4}$ $\frac{2}{3}$	$\frac{1}{3}$ $\frac{1}{10}$ $\frac{1}{5}$	$\frac{1}{4}$ $\frac{4}{5}$ $\frac{1}{8}$	$\frac{3}{5}$ $\frac{1}{2}$ $\frac{3}{4}$	$\frac{2}{3}$ $\frac{7}{10}$ $\frac{4}{5}$

Set III (5 minutes)

1.	$4\frac{1}{5}$ $1\frac{1}{4}$	$8\frac{1}{6}$ $9\frac{3}{5}$ $2\frac{1}{6}$	$\frac{5}{12}$ $\frac{3}{4}$ $\frac{5}{6}$	$6\frac{3}{4}$ $7\frac{2}{3}$	$8\frac{1}{4}$ $\frac{3}{5}$ $5\frac{1}{4}$
2.	$5\frac{1}{12}$ $\frac{5}{6}$	$\frac{5}{12}$ $2\frac{1}{3}$	$\frac{2}{3}$ $\frac{1}{12}$ $4\frac{1}{4}$	$\frac{2}{3}$ $1\frac{2}{5}$	$9\frac{5}{8}$ $3\frac{5}{6}$ $4\frac{17}{24}$

CALCULATING WAGES

Last summer Fred Jones and some of his friends worked part time at a beet-sugar factory. The boys were paid 48¢ an hour. They chose Fred to keep a record of the amount of time each of them worked each day. Here is a copy of his record.

	Mon.	Tues.	Wed.	Thu.	Fri.	Sat.	Total
Dick.....	$3\frac{1}{2}$	$4\frac{1}{4}$	$6\frac{3}{4}$	$4\frac{1}{4}$	5	0	?
Fred.....	4	$5\frac{1}{2}$	$7\frac{1}{4}$	8	$4\frac{3}{4}$	$2\frac{1}{2}$	?
Keith.....	$1\frac{1}{2}$	6	$\frac{1}{2}$	$6\frac{3}{4}$	$8\frac{1}{4}$	3	?
John.....	$2\frac{3}{4}$	$\frac{3}{4}$	$6\frac{1}{4}$	5	$4\frac{1}{4}$	$3\frac{3}{4}$	?
Carl.....	$5\frac{1}{4}$	8	$3\frac{1}{4}$	4	$5\frac{3}{4}$	2	?
Total.....	?	?	?	?	?	?	?

1. How many hours did the boys work on Monday? on Tuesday? on each of the remaining days?

2. How many hours did the boys work in all during this week? Save your answer.

3. How many hours did Dick work during the week? How many hours did each of the remaining boys work?

4. How many hours did each of the boys work in all? Use the numbers found in the answers for problem **3.**

5. Compare your answers for problems **2** and **4.** Why should they be the same?

***6.** On your paper rule a form similar to the one which Fred used. In place of the number of hours in the table, write the amount each boy earned each day.

***7.** Find the amount each boy earned during the week, and the total amount earned by all the boys.

***8.** Find the total amount the boys earned each day, and then find the total amount earned in the six days.

FINDING HARD SPOTS IN SUBTRACTION

Work these examples carefully. Be sure to get the answers in simplest form. After you are sure that you know how to work every example, practise for speed.

Set I (5 minutes)

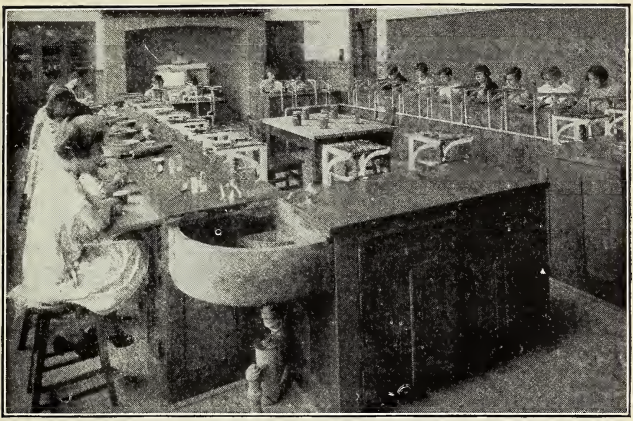
	a	*b*	*c*	*d*	*e*
1.	$\frac{3}{5}$	$\frac{5}{8}$	$\frac{5}{6}$	$4\frac{2}{3}$	$7\frac{3}{4}$
	$\underline{\frac{2}{5}}$	$\underline{\frac{1}{8}}$	$\underline{\frac{5}{6}}$	$\underline{\frac{1}{3}}$	$\underline{\frac{3}{4}}$
2.	$7\frac{5}{6}$	$8\frac{1}{2}$	$3\frac{2}{5}$	$4\frac{4}{5}$	$7\frac{5}{8}$
	$\underline{\frac{1}{6}}$	$\underline{4}$	$\underline{3}$	$\underline{1\frac{2}{5}}$	$\underline{2\frac{1}{8}}$
3.	$6\frac{5}{8}$	9	1	5	9
	$\underline{4\frac{5}{8}}$	$\underline{\frac{1}{4}}$	$\underline{\frac{1}{5}}$	$\underline{1\frac{2}{3}}$	$\underline{8\frac{1}{2}}$

Set II (5 minutes)

1.	$7\frac{1}{3}$	$7\frac{5}{8}$	$18\frac{1}{5}$	$8\frac{1}{3}$	$9\frac{1}{4}$
	$\underline{\frac{2}{3}}$	$\underline{\frac{7}{8}}$	$\underline{7\frac{2}{5}}$	$\underline{7\frac{2}{3}}$	$\underline{2\frac{3}{4}}$
2.	$\frac{1}{2}$	$\frac{1}{2}$	$3\frac{3}{4}$	$7\frac{5}{8}$	$9\frac{1}{3}$
	$\underline{\frac{1}{4}}$	$\underline{\frac{1}{6}}$	$\underline{\frac{1}{2}}$	$\underline{7\frac{1}{4}}$	$\underline{\frac{1}{12}}$
3.	$9\frac{5}{6}$	$8\frac{3}{5}$	$7\frac{3}{4}$	$8\frac{1}{4}$	$9\frac{1}{4}$
	$\underline{1\frac{2}{3}}$	$\underline{2\frac{1}{10}}$	$\underline{\frac{5}{6}}$	$\underline{\frac{11}{12}}$	$\underline{8\frac{3}{8}}$

Set III (5 minutes)

1.	$\frac{3}{4}$	$\frac{5}{8}$	$4\frac{5}{8}$	$9\frac{5}{6}$	$1\frac{1}{8}$
	$\underline{\frac{2}{3}}$	$\underline{\frac{1}{6}}$	$\underline{\frac{1}{3}}$	$\underline{\frac{3}{8}}$	$\underline{\frac{1}{3}}$
2.	$9\frac{5}{8}$	$9\frac{7}{8}$	$9\frac{5}{6}$	$8\frac{1}{8}$	$9\frac{1}{8}$
	$\underline{1\frac{2}{5}}$	$\underline{3\frac{1}{6}}$	$\underline{3\frac{3}{4}}$	$\underline{2\frac{1}{2}}$	$\underline{\frac{1}{3}}$
3.	$8\frac{3}{8}$	$6\frac{1}{4}$	$7\frac{1}{4}$	$9\frac{1}{5}$	$12\frac{2}{5}$
	$\underline{2\frac{5}{6}}$	$\underline{\frac{5}{6}}$	$\underline{3\frac{2}{3}}$	$\underline{\frac{2}{3}}$	$\underline{11\frac{3}{4}}$



CHANGING RECIPES

Alice and Catherine are doing good work in their cooking class. One reason for their success is that they do not make mistakes in arithmetic in changing recipes. These problems will give you practice in changing recipes.

1. A recipe for a cake of a certain size calls for $1\frac{1}{2}$ cups of milk. If you wished to make a cake of half the size called for in the recipe, how much milk would you use?

2. If you wished to make a cake twice as large as the one in the recipe, problem **1**, how much milk would you require?

3. Change the following recipe for making a pound of chocolate fudge to one for making 3 pounds of fudge; for making $\frac{1}{2}$ pound:

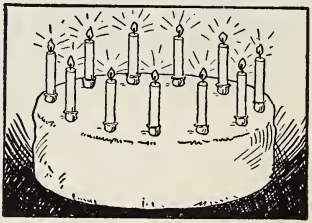
2 cups of sugar
$\frac{1}{4}$ cup of water
$\frac{3}{4}$ cup of milk
$\frac{1}{2}$ tablespoonful of butter
1 square of chocolate

4. A recipe for 3 dozen cookies requires $1\frac{3}{4}$ cups of brown sugar. How much sugar is required for a recipe for 6 dozen cookies? for 1 dozen?

5. Harry likes to bake pancakes. He uses $\frac{1}{4}$ cup of flour for 6 pancakes. How much flour will he use for 24 pancakes? for 30 pancakes? How many pancakes can Harry make with 3 cups of flour?

6. A certain cake recipe for 8 people requires $1\frac{1}{2}$ cups of sugar. How much sugar is required for a cake for 4 people? for 12 people? for 16 people? for your family at home? for your class in school?

7. A recipe for a chocolate cake large enough to serve 6 people requires $\frac{2}{3}$ cup of butter and $1\frac{3}{4}$ cups of sugar. How much butter and sugar are required for a cake for 3 people? for 12 people? for 8 people?



8. In making a batch of bread dough a baker uses 3.4 pounds of salt and 5.9 pounds of lard for each barrel of flour. How much of each does he need for $\frac{1}{2}$ barrel of flour? for $\frac{1}{4}$ barrel? for 8 barrels?

9. Alice's mother uses $4\frac{1}{2}$ pounds of flour in making 5 loaves of bread. How much flour does she need for 15 loaves of bread? How many loaves can she bake with 18 pounds of flour?

*10. Look up a recipe in a cookbook. Make up a problem about it like one of those given above. Bring your problem to class to be solved.

FINDING HARD SPOTS IN MULTIPLICATION

Work these examples carefully. Check your work at each step. Use cancellation whenever possible. Be sure to reduce all answers to simplest form. After your paper has been marked, find reasons for your errors.

Set I

	a	*b*	*c*
1.	$\frac{1}{4}$ of 8 =	$3 \times \frac{1}{8}$ =	$\frac{1}{4}$ of $\frac{1}{3}$ =
2.	$\frac{1}{6}$ of 2 =	$5 \times \frac{1}{5}$ =	$\frac{1}{4}$ of $\frac{8}{9}$ =
3.	$\frac{2}{9}$ of 2 =	$9 \times \frac{1}{3}$ =	$\frac{1}{4} \times \frac{5}{9}$ =
4.	$\frac{3}{4}$ of 17 =	$13 \times \frac{1}{5}$ =	$\frac{7}{8} \times \frac{2}{5}$ =
5.	$\frac{5}{8}$ of 18 =	$8 \times \frac{1}{6}$ =	$\frac{8}{25} \times \frac{3}{4} \times \frac{5}{6}$ =

Set II

1.	$9 \times 2\frac{1}{3}$ =	$2\frac{1}{4} \times 4$ =	$\frac{1}{3} \times 2\frac{1}{2}$ =
2.	$5 \times 6\frac{1}{3}$ =	$4\frac{1}{3} \times 2$ =	$\frac{1}{4}$ of $1\frac{2}{3}$ =
3.	$10 \times 4\frac{3}{4}$ =	$7\frac{1}{8} \times 6$ =	$\frac{7}{8} \times 4\frac{2}{5}$ =
4.	$2\frac{4}{5} \times 2 \times 3\frac{3}{8}$ =	$9\frac{2}{3} \times 8$ =	$\frac{3}{5} \times 4\frac{3}{4}$ =
5.	$2\frac{2}{3} \times 6 \times 4\frac{1}{8}$ =	$5 \times 2\frac{1}{6}$ =	$\frac{2}{3} \times 5\frac{5}{6} \times \frac{3}{4}$ =

Set III

1.	$2\frac{2}{3} \times \frac{2}{9}$ =	$2\frac{1}{3} \times 2\frac{1}{2}$ =	$40 \times 4\frac{1}{8}$ =
2.	$6\frac{2}{3} \times \frac{1}{8}$ =	$4\frac{4}{5} \times 6\frac{1}{4}$ =	$37\frac{1}{6} \times 17$ =
3.	$6\frac{2}{3} \times \frac{3}{5}$ =	$3\frac{3}{4} \times 6\frac{2}{3}$ =	$36\frac{3}{4} \times 16$ =
4.	$6\frac{2}{5} \times \frac{3}{7}$ =	$3\frac{1}{4} \times 2\frac{2}{3}$ =	$34 \times 83\frac{4}{5}$ =
5.	$6\frac{2}{5} \times 5 \times \frac{3}{8}$ =	$3\frac{4}{7} \times 1\frac{4}{5} \times 9\frac{3}{8}$ =	$22 \times 24\frac{5}{6}$ =

When you are sure that you can work the examples correctly, practise for speed. You should be able to work correctly all of the examples in each set in less than five minutes. Watch your progress in several trials of each set.

EARNING MONEY

In the county in which Arthur lives, boys and girls are employed to pick cherries at a certain price a quart. Here are some problems about the cherry pickers.

1. Arthur picked 1,023 quarts of cherries in $15\frac{1}{2}$ hours. How many quarts did he average an hour?

2. Harry worked from 5 A.M. until 7 P.M. He ate lunch from 12 to 12:30. In all he picked 720 quarts of cherries. How many quarts an hour did he average?

3. Which boy had the better record for an hour's picking? How many quarts an hour better?

4. Harry received \$16.20 for his day's work. How much did he receive for each quart of cherries he picked?

5. At the same rate a quart how much did Arthur earn in the $15\frac{1}{2}$ hours he worked? How much an hour?

6. How much did Harry earn an hour?

7. In problem **4** you found the amount paid for picking 1 quart of cherries. At this rate how many quarts will a boy have to pick to earn \$1.80?

8. A crate of cherries contains 16 quarts. How many crates did Arthur pick? How many did Harry pick?

9. At \$.86 a crate how much did Mr. Jordan, the owner of the orchard, receive for the cherries Arthur picked?

10. Tom picks on the average 32 quarts of cherries an hour. At that rate how much does he earn in 10 hours if he is paid $2\frac{1}{2}$ cents a quart for picking?

11. Last summer the pickers were paid $2\frac{1}{2}$ cents a quart for picking cherries. In $8\frac{1}{2}$ hours Tom picked 510 quarts. How much an hour did he earn on the average?

FINDING HARD SPOTS IN DIVISION

These sets of examples will help you to discover your difficulties in the division of fractions. Be sure to invert the divisor before multiplying. Check your work at each step. Be sure to get the answers in simplest form. After your paper has been marked, try to find the reasons for your errors. Do not be satisfied until you can work every example correctly.

Set I

1. *a.* $8 \div \frac{1}{4} =$	**2.** *a.* $\frac{1}{4} \div \frac{1}{3} =$	**3.** *a.* $1\frac{1}{5} \div \frac{1}{2} =$
b. $7 \div \frac{3}{4} =$	*b.* $\frac{1}{8} \div \frac{1}{4} =$	*b.* $1\frac{1}{3} \div \frac{1}{3} =$
c. $15 \div \frac{3}{5} =$	*c.* $\frac{2}{3} \div \frac{2}{3} =$	*c.* $5\frac{1}{6} \div \frac{3}{10} =$
d. $12 \div \frac{8}{9} =$	*d.* $\frac{4}{5} \div \frac{1}{3} =$	*d.* $4\frac{1}{8} \div \frac{3}{4} =$
e. $5 \div \frac{10}{11} =$	*e.* $\frac{5}{6} \div \frac{3}{8} =$	*e.* $6\frac{2}{3} \div \frac{2}{3} =$

Set II

1. *a.* $\frac{1}{4} \div 3 =$	**2.** *a.* $1\frac{1}{2} \div 7 =$	**3.** *a.* $\frac{1}{4} \div 1\frac{2}{3} =$
b. $\frac{3}{5} \div 4 =$	*b.* $4\frac{2}{5} \div 8 =$	*b.* $\frac{3}{8} \div 2\frac{1}{4} =$
c. $\frac{5}{6} \div 5 =$	*c.* $7\frac{2}{3} \div 6 =$	*c.* $\frac{5}{6} \div 4\frac{2}{3} =$
d. $\frac{8}{9} \div 6 =$	*d.* $8\frac{4}{5} \div 2 =$	*d.* $\frac{1}{6} \div 1\frac{2}{3} =$
e. $\frac{1}{2} \div 1 =$	*e.* $3\frac{1}{2} \div 7 =$	*e.* $\frac{7}{16} \div 1\frac{3}{4} =$

Set III

1. *a.* $7 \div 7\frac{1}{6} =$	**2.** *a.* $1\frac{1}{3} \div 2\frac{1}{2} =$	**3.** *a.* $276\frac{1}{4} \div 4 =$
b. $4 \div 5\frac{3}{4} =$	*b.* $1\frac{2}{3} \div 6\frac{2}{3} =$	*b.* $358\frac{1}{2} \div 7 =$
c. $15 \div 2\frac{1}{2} =$	*c.* $5\frac{7}{9} \div 5\frac{7}{9} =$	*c.* $3\frac{1}{15} \div 2\frac{2}{9} =$
d. $8 \div 3\frac{2}{3} =$	*d.* $8\frac{1}{5} \div 2\frac{1}{4} =$	*d.* $3\frac{1}{3} \div 8 =$
e. $15 \div 2\frac{2}{5} =$	*e.* $7\frac{1}{2} \div 2\frac{1}{2} =$	*e.* $\frac{1}{4} \div \frac{1}{8} =$

When you are sure that you know how to work each example correctly, practise for speed. You should be able to complete the examples in each set in less than five minutes. Try never to repeat a mistake.

COMPARING THE YIELDS OF OUR CROPS

Our government has collected information about the crops raised by our farmers. It has been found that crops vary widely from year to year. Sometimes the yield is larger than the "long time" average, sometimes it is less. Below are some facts about yields per acre.

Crop	Yield		Value in 1932
	"Long Time"	1932	
Wheat (bu.)	17.1	15.8	$.30
Oats (bu.)	32.3	29.8	.18
Barley (bu.)	25.2	21.5	.20
Rye (bu.)	16.1	11.6	.17
Corn (bu.)	49.3	38.9	.45
Flaxseed (bu.)	8.8	5.4	.52
Hay and Clover (T.)	1.5	1.54	7.10
Alfalfa (T.)	2.4	2.65	8.55
Sugar beets (T.)	9.4	10.00	5.32

1. "Long time" yield is the average for many years. For how many of the crops listed in the table were the 1932 yields less than the "long time" average? For how many were they greater?

2. How much more than in 1932 was the "long time" yield of wheat? of oats? of barley? of rye? of corn?

3. How much more than the "long time" yield was the 1932 yield of hay and clover? of alfalfa? of beets?

4. Find the value of the 1932 yield per acre of wheat.

5. For which of the 1932 crops listed in the table was the value of the crops at 1932 prices the greatest? the smallest?

***6.** Compare the yields and prices given above for all of Canada with the yields and prices of your own locality.

SURVEY TESTS IN DECIMALS

ADDITION (6 minutes)

1. .5	**3.** .06	**5.** .16	**7.** .04	**9.** 4.25
.2	.04	.34	.02	6.
.1	.03	.27	.01	8.755
2. .8	**4.** 1.73	**6.** .48	**8.** 1.26	**10.** 3.11
.8	2.65	.53	.483	24.
.9	4.93	.69	.9	.6

11. Find the sum of 7.46, 8.375, and 3.1.

12. Find the sum of 9.864, 20, and .4.

SUBTRACTION (5 minutes)

1. .9	**5.** .463	**9.** .7	**13.** 46.23	**17.** .84
.4	.358	.652	14.76	.7
2. .8	**6.** .9	**10.** .9	**14.** 8.3	**18.** 1.465
.8	.43	.002	6.25	.97
3. .14	**7.** .8	**11.** 8.4	**15.** 17.4	**19.** 4.352
.02	.375	7.1	1.675	3.
4. .47	**8.** .54	**12.** 14.5	**16.** 19.58	**20.** 4.952
.32	.51	9.6	6.3	4.9

21. Subtract 4.95 from 20. **22.** From .96 subtract .4.

MULTIPLICATION (10 minutes after copying)

1. $6 \times .1 =$	**2.** $3 \times .03 =$	**3.** $4 \times .002 =$
4. $7 \times .4 =$	**5.** $8 \times .06 =$	**6.** $6 \times .009 =$
7. $8 \times .5 =$	**8.** $5 \times .06 =$	**9.** $6 \times .005 =$

10. 5.7	**11.** 4.5	**12.** 5.64	**13.** 9.853
9	8	7	2

14. 85 × .6	**15.** 30 × .9	**16.** 28 × 1.4	**17.** 3.5 × 48

18. .3 × .3 = **19.** 1,000 × 4.82 = **20.** .8 × .75 =

21. 5.4 × 3.2	**22.** 5.6 × 8.5	**23.** 14.8 × .62	**24.** 4.08 × 1.03

25. 10 × 76.2 = **26.** .4 × .07 **27.** .100 × .436 =

DIVISION (12 minutes after copying)

Carry the work to three places when necessary.

1. $5\overline{)9.5}$	**11.** $8\overline{)6}$	**21.** $.4\overline{)3}$
2. $4\overline{)7.84}$	**12.** $50\overline{)4}$	**22.** $.9\overline{)5}$
3. $9\overline{)19.269}$	**13.** $25\overline{)72}$	**23.** $.12\overline{)1.44}$
4. $4\overline{).8}$	**14.** $33\overline{)90}$	**24.** $.11\overline{)1.694}$
5. $8\overline{).96}$	**15.** $15\overline{)6.225}$	**25.** $.15\overline{)4.5}$
6. $3\overline{).852}$	**16.** $.3\overline{)8.1}$	**26.** $.18\overline{)9}$
7. $7\overline{).14}$	**17.** $.7\overline{)18.13}$	**27.** $.16\overline{)12}$
8. $6\overline{).036}$	**18.** $.2\overline{)1.2}$	**28.** $2.25\overline{)6.75}$
9. $36\overline{)1.8}$	**19.** $.3\overline{)9}$	**29.** $7.32\overline{)8.052}$
10. $6\overline{)3}$	**20.** $.4\overline{)20}$	**30.** $.125\overline{)13.75}$

31. Divide the following by 10; by 100:

a	*b*	*c*	*d*	*e*
3.75	18.2	65	28.75	10.7

Use the practice exercises on pages 25, 26, and 27 for special work in the processes in which your scores on these tests were unsatisfactory.

REPRESENTATION IN THE HOUSE OF COMMONS

The members of the House of Commons are elected by the people of the provinces of Canada. The British North America Act fixes the number of members of the House of Commons from Quebec at 65. Each of the other provinces is allowed a number of members which bears the same ratio to its population as 65 is to the population of Quebec.

1. According to the census of 1931 Quebec had a population of 2,874,683. What was the ratio of the population of Quebec to the number of its representatives in the House of Commons?

2. By Act of Parliament the ratio was taken as 44,185. How does this number compare with your answer to problem **1**? Account for the slight difference.

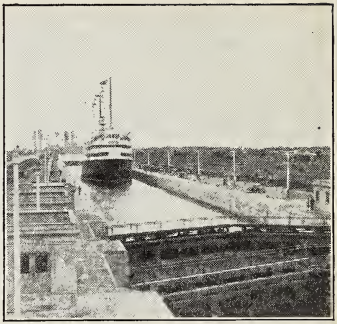
3. Assuming that there is to be one representative in the House of Commons for every 44,185 people, find the number of members to which Saskatchewan is entitled if the population of that province is 921,785.

4. The census of 1931 showed the populations of other Western Provinces of Canada to be as follows: Alberta, 731,605; British Columbia, 694,263; Manitoba, 700,139. To how many members in the House of Commons is each of these provinces entitled?

5. The total number of members of the House of Commons was, in 1935 A.D., 245. What ratio did the number of members from Quebec bear to the total membership? Express your answer (1) as a fraction; (2) as a decimal.

***6.** If the population of Quebec grew very rapidly in proportion to the rest of Canada, what effect would this have on the number of members in the House of Commons?

THE WELLAND CANAL



1. The Welland Canal, one of the greatest engineering feats in the world was constructed at a cost of $135,000,000. It is 27.7 miles long. What was the average cost of construction a mile?

2. There is a total drop of 326.5 feet from Lake Erie to Lake Ontario. What is the average drop a mile? (Express answer as a 2-place decimal.)

3. There are 7 lift locks and 1 guard lock in the canal. What is the average lift of the locks on the Welland Canal? (Do not count the guard lock.)

4. The estimated time required for a vessel to pass through the Welland Canal is 8 hours. Vessels pass through the canal at an average rate of how many miles an hour?

5. A lock fills in 8 minutes. If the lift of the lock was 46.5 feet what is the lift per minute?

6. Lock No. 8 is 1,380 feet long. It is the largest lock in the world. The length of this lock is what fraction of a mile? Reduce the fraction to a decimal.

*7. Find other important facts regarding the Welland Canal such as the tonnage of the freight traffic passing through the canal in a year, the cost of operation, etc.

*8. Draw a picture illustrating how a vessel passes through a lock (1) going up; (2) going down.

CHANGING THE FORM OF FRACTIONS

1. Change the following to common fractions:

a	*b*	*c*	*d*	*e*	*f*
.7	.74	.06	$.12\frac{1}{2}$	.25	$.33\frac{1}{3}$

2. Change the following to decimals:

a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
$\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{5}$	$\frac{7}{8}$	$\frac{2}{3}$	$\frac{5}{9}$	$\frac{11}{12}$	$\frac{19}{30}$

PRACTICE IN ADDITION AND SUBTRACTION OF DECIMALS

Use these practice exercises for special work in decimals.

☞*In addition or subtraction of decimals, the decimal points must be placed in a straight line one under the other.*

Copy and add the following:

1. .6 + .2 + .1 =
2. .5 + .4 + .8 =
3. .07 + .08 + .09 =
4. 1.46 + 1.53 + 2.48 =
5. .18 + .42 + .25 =
6. .97 + .46 + 53 =
7. .05 + .01 + .02 =
8. 1.35 + 1.6 + 3.759 =
9. .9 + .84 + 12.375 =
10. 3.19 + 25 + .8 =

Copy and subtract the following:

1. .8 − .4 =
2. .6 − .6 =
3. .18 − .04 =
4. .56 − .35 =
5. .492 − .185 =
6. .8 − .27 =
7. .9 − .675 =
8. .73 − .71 =
9. .5 − .453 =
10. .8 − .006 =
11. 9.7 − 6.2 =
12. 18.3 − 7.4 =
13. 58.54 − 15.77 =
14. 8.5 − 6.42 =
15. 18.6 − 5.875 =
16. 24.36 − 1.4 =
17. .97 − .4 =
18. 1.483 − .99 =
19. 8.27 − 8 =
20. 16.843 − 16.8 =

PRACTICE IN MULTIPLICATION OF DECIMALS

☞*Point off as many places in the product as there are decimal places in the multiplier and the multiplicand. Count from the right.*

1. Show that the following products are correct:

a. $.5 \times .7 = .35$
b. $.6 \times 3.84 = 2.304$
c. $7 \times 2.4 = 16.8$
d. $.12 \times .11 = .0132$
e. $.5 \times .4 = .2$
f. $.6 \times .03 = .018$

2. Where should the decimal points in the following products be placed?

a. $.7 \times 9 = 63$
b. $.12 \times 1.4 = 168$
c. $5 \times .8 = 40$
d. $.04 \times .18 = 72$
e. $.6 \times .4 = 24$
f. $1.8 \times 2.5 = 450$

Multiply the following:

3. $7 \times .1 =$
4. $8 \times .4 =$
5. $4 \times .5 =$
6. $8.6 \times 9 =$
7. 4.756×3
8. 82×4.1
9. $.5 \times .07 =$
10. $3.5 \times 8.6 =$
11. $4 \times .02 =$
12. $6 \times .08 =$
13. $5 \times .08 =$
14. $5.5 \times 8 =$
15. $48 \times .5$
16. 4.5×24
17. $.6 \times .25 =$
18. $.74 \times 23.1 =$
19. $3 \times .003 =$
20. $8 \times .004 =$
21. $8 \times .005 =$
22. $7.36 \times 2 =$
23. $40 \times .4$
24. $.3 \times .2$
25. $4.7 \times 9.3 =$
26. $4.03 \times 8.09 =$

27. Multiply each of the following by 10; 100; 1,000:
.01 .15 3.7 96.42 .875 9.375

28. Give a short cut for multiplying by 25; 50; $33\frac{1}{3}$; 20; $12\frac{1}{2}$; 75; $37\frac{1}{2}$; $66\frac{2}{3}$; 40.

PRACTICE IN DIVISION OF DECIMALS

1. State the rule for placing the decimal point in the quotient in division of decimals.

2. Apply the rule to the following examples:

a. $3\overline{)8.76}$ = 2.92 *b.* $4\overline{).16}$ = .04 *c.* $.9\overline{)37.8}$ = 42 *d.* $1.25\overline{)37.50}$ = 30

3. Where should the decimal point be placed in the following quotients?

a. $4\overline{)9.64}$ = 241 *b.* $5\overline{).015}$ = 3 *c.* $1.1\overline{)12.1}$ = 11 *d.* $.25\overline{)4.00}$ = 16

Find the quotients in the following:

4. $4\overline{)9.6}$

5. $5\overline{)8.75}$

6. $7\overline{)16.387}$

7. $3\overline{).6}$

8. $8\overline{).88}$

9. $6\overline{).972}$

10. $9\overline{).18}$

11. $8\overline{).048}$

12. $32\overline{)1.6}$

13. $4\overline{)2}$

14. $12\overline{)9}$

15. $20\overline{)1}$

16. $15\overline{)48}$

17. $66\overline{)90}$

18. $12\overline{)6.492}$

19. $.4\overline{)9.2}$

20. $.7\overline{)25.34}$

21. $.5\overline{)2.5}$

22. $.4\overline{)8}$

23. $.2\overline{)10}$

24. $.8\overline{)6}$

25. $.7\overline{)4}$

26. $.13\overline{)1.69}$

27. $.11\overline{)1.859}$

28. $.16\overline{)4.8}$

29. $.24\overline{)12}$

30. $.24\overline{)18}$

31. $2.25\overline{)11.25}$

32. $4.27\overline{)3.924}$

33. $.375\overline{)81.25}$

34. Give a short-cut method of dividing by 25; by 50; $33\frac{1}{3}$; $12\frac{1}{2}$; 10; 100; 1000; 20.

DIFFERENT WAYS OF EXPRESSING QUANTITIES

The same quantity may often be expressed in different ways. For example: 5 cents, \$.05, $\$\frac{1}{20}$, 5¢, all mean the same; 6 in., $\frac{1}{2}$ ft., .5 ft., $\frac{1}{6}$ yd., .16$\frac{2}{3}$ yd., all mean the same. Show why.

Express each of the following quantities in three or more ways:

1. 8¢
2. 8 in.
3. $\frac{1}{4}$ mi.
4. 2.25 lb.
5. .75 yd.
6. 2 qt. 1 pt.
7. 2 yd. 6 in.
8. 2 hr. 15 min.
9. 1 bu. $\frac{1}{2}$ pk.

10. Show that the following mean the same: $\frac{1}{4} \times 20$, $.25 \times 20$, 25% of 20, $20 \times \frac{1}{4}$.

Express the following in three ways:

11. $\frac{1}{2} \times$
12. $.75 \times$
13. 20% of
14. $\frac{1}{10}$ of
15. 50% of
16. .4 of
17. $33\frac{1}{3}$% of
18. $\times \frac{2}{5}$
19. $1\frac{1}{4} \times$
20. $\frac{3}{8} \times$
21. $\frac{1}{4} \times$
22. $\frac{2}{3} \times$

Common fractions may be changed to decimals. Change the following to three-place decimals:

23. $\frac{1}{9}$
24. $\frac{2}{7}$
25. $\frac{5}{6}$
26. $\frac{5}{8}$
27. $\frac{9}{16}$
28. $\frac{12}{31}$
29. $\frac{14}{29}$
30. $\frac{15}{44}$
31. $\frac{28}{33}$
32. $\frac{35}{46}$

*__33.__ Arrange the fractions in problems **23** to **32** in the order of size, using the decimal values.

34. Find the combined length of two boards, one 5 feet 6 inches long, the other 4 feet 3 inches long. Express the answer in two ways: as feet and fractions of a foot, and as feet and inches.

35. Find the total weight in pounds of a dozen cans of peaches, each weighing 1 pound 4 ounces.

36. Find the cost of a load of coal weighing 2,400 pounds at \$18.50 a short ton (2000 lb.).

SURVEY TESTS IN PER CENT (2 minutes each)

Use these tests to locate your weaknesses in per cents.

Test I. Reduce these decimals to per cents:

1. .25	**3.** .37½	**5.** .468	**7.** .09	**9.** .4
2. 1.25	**4.** .06¼	**6.** .6	**8.** 3.52½	**10.** 2.5

Test II. Reduce these per cents to decimals:

1. 35%	**3.** 27.4%	**5.** 8%	**7.** 41⅓%	**9.** ½%
2. 50%	**4.** 7¼%	**6.** 120%	**8.** ¾%	**10.** 215¼%

Test III. Reduce these per cents to their simplest fractional forms:

1. 50%	**3.** 12½%	**5.** 40%	**7.** 33⅓%	**9.** 25%
2. 60%	**4.** 75%	**6.** 66⅔%	**8.** 87½%	**10.** 16⅔%

Test IV. Using a pencil only when necessary, find:

1. 6% of \$125	**4.** ⅖% of 400	**7.** 125% of 32
2. 7% of \$432	**5.** ⅓% of 600	**8.** 75% of 80
3. 3.5% of \$468	**6.** 12½% of 160	**9.** 224% of 400

Test V. Find what per cent:

1. 27 is of 108	**4.** 56 is of 40	**7.** 8 is of 400
2. 120 is of 150	**5.** 80 is of 64	**8.** 2 is of 600
3. 16 is of 36	**6.** 320 is of 576	**9.** 150 is of 125

Test VI. Find the missing number:

1. 10% of —— = 20	**4.** 60% of —— = 4.8
2. 4% of —— = \$80	**5.** ½% of —— = 4
3. 12½% of —— = 25	**6.** 150% of —— = 300

Test VII. Work these mixed examples:

1. Express ½, ⅓, ¼, .09, .4 and 2.25 as per cents.

2. Express as decimals: 20%; 8%; 204%.

3. Find 8½% of \$2,000.

4. 12% of —— = 36.

5. Find what per cent 20 is of 80.

WHICH COWS PRODUCE THE RICHEST MILK?

Below is given a table from a government report showing the per cent of butterfat in the milk of some well-known breeds of dairy cows:

	Per Cent of Butterfat or Pounds of Cream a Hundred Pounds
Holstein-Friesian	3.4
Ayrshire	3.6
Shorthorn	4.4
Deron	4.6
Guernsey	5.3
Jersey	5.6

1. Which breed produces the richest milk? Which breed produces the smallest per cent of butterfat?

2. What is the difference in the number of pounds of butterfat a hundred produced by the Jersey and Guernsey breeds? the Jersey and the Holstein-Friesian breeds?

3. At the rates above how much butterfat would there be in 1,000 pounds of milk from Jersey cows? from Holstein-Friesian cows? from each of the other breeds of cows?

4. A pound of butterfat produces 1.12 pounds of butter. How many pounds of butter are produced on the average from 1,000 pounds of Guernsey milk? of Ayrshire milk?

5. One pound of 4% milk equals about .388 quart. Find the value of 1,000 lb. of 4% milk at $3\frac{1}{2}$¢ a quart.

6. One thousand pounds of 4% milk sold to a creamery to be made into butter produce the following:

Butterfat.....— lb. at 35¢ a lb.
Skim milk.....800 lb. at 25¢ a cwt.
Buttermilk.....160 lb. at 25¢ a cwt.

Find the total value of the above three items.

*7. Which yields larger returns, selling 1,000 pounds of 4% milk at $3\frac{1}{2}$ cents a quart, or making it into butter?

PER CENTS, DECIMALS, AND FRACTIONS RELATED

You have learned that there are three ways of expressing parts of things. In each of the following examples select the correct parts. How many of the examples can you complete in five minutes?

1. 25% equals .25, $\frac{1}{4}$, $\frac{25}{100}$, $\frac{2}{5}$, 2.5.
2. 20% equals .2, .02, $\frac{20}{100}$, $\frac{3}{5}$, $\frac{2}{5}$, $\frac{1}{5}$.
3. 50% equals .05, $\frac{50}{100}$, 0.5, $\frac{1}{2}$, $\frac{5}{10}$.
4. $33\frac{1}{3}$% equals .33$\frac{1}{3}$, $\frac{2}{3}$, 1.3, $\frac{5}{6}$, $\frac{1}{3}$.
5. $\frac{3}{4}$ equals 0.75, 1.33, .075, 75%.
6. $\frac{7}{8}$ equals 8.75, 87.5%, .875, .0875.
7. $37\frac{1}{2}$% equals $\frac{5}{8}$, $\frac{3}{8}$, .375, 37.5%.
8. $\frac{2}{5}$ is more than $\frac{1}{2}$, 33%, .75, 25%, .5, .4%.
9. .5 yd. equals 18 in., $1\frac{1}{2}$ ft., 1.5 ft., 1.75 ft.
10. .75 lb. equals $\frac{4}{5}$ lb., 12 oz., $\frac{3}{4}$ lb., $\frac{12}{16}$ lb.

What fractional part of the ten examples did you have correct? What per cent was this?

Commonly used equivalents. Below are some of the more commonly used per cents and their fractional equivalents. Commit to memory the fractional equivalent of each per cent.

50% = $\frac{1}{2}$	$66\frac{2}{3}$% = $\frac{2}{3}$	$62\frac{1}{2}$% = $\frac{5}{8}$	40% = $\frac{2}{5}$
25% = $\frac{1}{4}$	$12\frac{1}{2}$% = $\frac{1}{8}$	$87\frac{1}{2}$% = $\frac{7}{8}$	60% = $\frac{3}{5}$
75% = $\frac{3}{4}$	$37\frac{1}{2}$% = $\frac{3}{8}$	20% = $\frac{1}{5}$	80% = $\frac{4}{5}$
$33\frac{1}{3}$% = $\frac{1}{3}$			

Use the fractional equivalent in finding the following:

	a	*b*	*c*
1.	50% of 60 =	20% of 50 =	$12\frac{1}{2}$% of \$9.60 =
2.	25% of 8 =	$33\frac{1}{3}$% of 27 =	$66\frac{2}{3}$% of 300 =
3.	75% of 12 =	$12\frac{1}{2}$% of \$4.80 =	25% of 400 =
4.	$33\frac{1}{3}$% of 9 =	50% of 100 =	$37\frac{1}{2}$% of 600 =

	a	*b*	*c*
5.	40% of \$65 =	80% of \$6.50 =	60% of \$7.50 =
6.	$66\frac{2}{3}$% of 12 =	$37\frac{1}{2}$% of 48 =	40% of 250 =
7.	$12\frac{1}{2}$% of 8 =	40% of 80 =	75% of 720 =
8.	$37\frac{1}{2}$% of 16 =	25% of 60 =	$33\frac{1}{3}$% of 900 =
9.	$87\frac{1}{2}$% of 24 =	$66\frac{2}{3}$% of 45 =	50% of 1,000 =

Everyday problems in percentage. **1.** At the school store Harry bought a textbook for which he paid 10% less than the regular price of \$1.40. How much did Harry pay for the book?

2. John sold his bicycle, which he had used for two years, for \$18. If the bicycle, when new, had cost him \$30, what per cent less than the cost did he receive for it?

3. Mary's sister had her wages increased from \$3.60 a day to \$3.96 a day. What was the per cent of increase?

4. About 20% of the population of any city are children of school age. Find the approximate population of a city if the school population is 2,568.

5. A cotton crop was reduced about 45% by the boll weevil and other causes. If the crop actually raised amounted to 15,660 pounds, what was the total possible crop?

6. A \$25 suit of clothes was sold for \$22.50. What was the per cent of reduction?

7. After an illness Jane weighed $94\frac{1}{2}$ pounds. This was $5\frac{1}{2}$ pounds below her normal weight. What per cent less than normal did Jane weigh?

8. Mr. Anderson's prize Jersey, Molly O, yielded milk which contained 4.2% butterfat. If she yielded an average of 50 pounds of milk a day, what was the value of the butterfat from the milk for one week at 32¢ a pound?

BUYING AT A DISCOUNT

1. Mr. Corcoran bought a lawn mower, regularly priced at \$14.75, at a discount of 20%. How much discount did he receive?

In this problem you are asked to *find a per cent of a number.*
20% of \$14.75 = .20 of \$14.75.
To find .20 of a number multiply by .20.
20% of \$14.75 = .20 × \$14.75 = \$2.95, *the discount.*

\$14.75
.20
\$2.9500

2. Alfred bought a \$6.00 chair for \$5.25. What was the per cent of discount?

In this problem you are asked to find what per cent the discount is of the regular price; that is, *what per cent one number is of another.*
The discount is \$6.00 − \$5.25 or \$.75.
\$.75 = ?% of \$6.00.
Divide \$.75 by \$6.00, carrying the work to two decimal places.
\$.75 ÷ \$6.00 = .12½.
Since hundredths may be expressed as per cent, .12½ equals 12½%.
The rate of discount is 12½%.

$$6)\overline{.75} \quad .12\tfrac{1}{2}$$

3. At a sale Margaret paid \$12 for a hat. This was 80% of the regular price. What was the regular price?

In this problem you are asked to find the regular price of the hat; that is, *to find a number when a per cent of it is given.*
80% of the price = \$12.
.80 × ? = \$12. To find the missing number, divide \$12 by .80.
\$12 ÷ .80 = \$15, the regular price.
Show that 80% of \$15 = \$12.

\$15.
.80)\$12.00
80
4 00
4 00

GRADED PRACTICE IN PER CENT

1. Express the following as per cents:

a. .05	*d.* 1.825	*g.* 1.8	*j.* .164
b. 1.18	*e.* .4	*h.* $1.33\frac{1}{3}$	*k.* 5.
c. .65	*f.* $.67\frac{1}{2}$	*i.* .025	*l.* .18

2. Express the following as decimals:

a. 6%	*d.* 30%	*g.* 118.4%	*j.* 400%
b. 13.5%	*e.* 118%	*h.* 102%	*k.* $3\frac{1}{2}\%$
c. 17%	*f.* $66\frac{2}{3}\%$	*i.* $167\frac{1}{2}\%$	*l.* 4.2%

3. Express the following as hundredths and as per cents:

a. $\frac{1}{5}$	*c.* $\frac{9}{10}$	*e.* $\frac{3}{50}$	*g.* $\frac{3}{4}$
b. $\frac{2}{3}$	*d.* $\frac{6}{25}$	*f.* $\frac{5}{8}$	*h.* $\frac{1}{6}$

Find the answers to the following:

	a	*b*	*c*
1.	6% of 90	7% of 78	5% of 74.3
2.	20% of 700	10% of 740	40% of 685
3.	12.5% of 720	37.5% of 648	62.5% of 746
4.	$37\frac{1}{2}\%$ of 96	$33\frac{1}{3}\%$ of 996	$16\frac{2}{3}\%$ of 978
5.	16% of 2,000	24% of 756	49% of 864
6.	$2\frac{1}{2}\%$ of 400	$3\frac{1}{2}\%$ of 427	$5\frac{1}{2}\%$ of 467
7.	7.5% of 800	3.4% of 780	6.2% of 784

Find the answers to the following:

1.	200% of 40	300% of 596	500% of 860
2.	105% of 300	108% of 465	207% of 759
3.	112% of 500	137% of 562	146% of 850
4.	130% of 600	150% of 850	250% of 790
5.	$133\frac{1}{3}\%$ of 750	$137\frac{1}{2}\%$ of 640	$112\frac{1}{2}\%$ of 624
6.	105.2% of 1,000	110.4% of 800	116.4% of 1,800
7.	210% of 2,000	304.6% of 900	$247\frac{1}{2}\%$ of 900

Find the missing per cents:

1. 5 = —% of 20
2. 4 = —% of 8
3. 3 = —% of 100
4. 6.4 = —% of 200
5. $7\frac{1}{2}$ = —% of $22\frac{1}{2}$
6. 6 = —% of 24
7. 20 = —% of 100
8. 6 = —% of 200
9. 7.2 = —% of 40
10. $6\frac{1}{2}$ = —% of 39

Find the missing per cents:

1. 100 = —% of 50
2. 65 = —% of 65
3. 115 = —% of 100
4. 104 = —% of 100
5. 900 = —% of 7,200
6. \$.08 = —% of \$1.20
7. 300 = —% of 100
8. $96\frac{1}{2}$ = —% of 96.5
9. 400 = —% of 160
10. 1,125 = —% of 1,000
11. 1,025 = —% of 900
12. \$9.60 = —% of \$9.60

Find the missing numbers:

1. 6% of —— = 30
2. 10% of —— = 80
3. 12.5% of —— = 80
4. $66\frac{2}{3}$% of —— = 40
5. 18% of —— = 54
6. $2\frac{1}{2}$% of —— = 10
7. 4.5% of —— = 60
8. 9% of —— = 18
9. 16 = 20% of ——
10. 37.5% of —— = 27
11. $33\frac{1}{3}$% of —— = 50
12. 15% of —— = 45
13. $7\frac{1}{2}$% of —— = 600
14. 2.5% of —— = 40

Find the missing numbers:

1. 200% of —— = 400
2. 104% of —— = 416
3. 125% of —— = 500
4. 120% of —— = 720
5. $112\frac{1}{2}$% of —— = 900
6. 113.5% of —— = 11,350
7. 230% of —— = 2,300
8. 300% of —— = 60
9. 105% of —— = 630
10. 175% of —— = 700
11. 140% of —— = 700
12. $137\frac{1}{2}$% of —— = 1,100
13. 106.4% of —— = 3,195
14. 350% of —— = 11,500

SELLING GOODS

1. Mr. Dreiman sold potatoes for 20% more than they cost. If they cost \$.80 a basket, what was the selling price? This problem can be solved in two ways:

I. Find 20% of \$.80. This is \$.16.
\$.80 + \$.16 = \$.96, the selling price.

\$.80	\$.80
.20	.16
\$.1600	\$.96

II. A number equal to 20% more than the cost price is equal to 120% of the cost price.
120% of \$.80 = \$.96.

\$.80
1.20
\$.96

Is it correct to say that Mr. Dreiman's profit was \$.16 on each basket of potatoes?

Find the selling prices of the following, using both methods:

2. \$.80 increased by 25%
3. \$.75 increased by 8%
4. \$12.50 increased by 20%
5. \$9.80 increased by 5%
6. \$7.28 increased by 25%
7. \$6.25 increased by 15%

8. Find 125% of 80; of 60; 40; 54; 78, and 95.

9. A dealer sold some cloth at \$1.20 a yard. He had paid \$1.00 a yard for this cloth. What per cent of the cost of the cloth was the selling price?

Think: \$1.20 = —% of \$1.00.

Find the missing numbers:

10. \$3.00 = —% of \$2.00
11. \$.60 = —% of \$.50
12. \$40 = —% of \$36
13. 76 = —% of 60
14. \$4.20 = —% of \$33.60
15. \$1.80 = —% of \$150
16. \$.86 = —% of \$10.32
17. \$9.60 = —% of \$4.80
18. \$4.86 = —% of \$4.50
19. \$7.50 = —% of \$7.50

MILK—ITS COST TO THE CONSUMER

1. The cost of milk to the consumer is distributed as follows:

Amount paid to farmer	50.5%
Amount paid for transportation	7.5%
Expense for handling at plant	18.0%
Expense of delivery	24.0%

If milk sells at 15¢ a quart to the consumer, how much of that amount is paid for each of the items above?

2. In a recent year the cost of milk a quart, delivered, in Winnipeg included:

Pasteurizing and cooling, a quart	$0.0030
Transportation from country, a quart	.0050
Bottles	.0025
Refrigeration, icing, etc	.0017
Cost of delivery	.0325
Other expenses, losses, and profits	.0146
Total expense of distribution	?
Paid to producer	.0707
Total retail price	?

Find the total expense of distribution; the retail price of the milk.

3. What per cent of the retail price did the producer receive?

4. What per cent of the retail price was paid for pasteurizing? for delivery? for transportation from the country?

***5.** In problem **2** are listed the items in the cost of distributing the milk. What items would you list under the cost of producing milk included in the $.0707 a quart?

***6.** Construct a circle graph showing the distribution of the cost of milk to the consumer, according to the items in problem **1.**

HOW THE FARMER SELLS HIS CROPS

Sometimes the farmer sells his crops and cattle directly to merchants in neighbouring towns or cities. Sometimes he ships them to some large centre, such as Winnipeg, where they are sold by commission merchants. Sometimes groups of farmers organize coöperative associations which control the sale of all of the products.

1. An agent in Port Arthur sold a shipment of wheat for Mr. Smith for \$3,760. The commission was $1\frac{1}{2}\%$. Find the amount which the agent should remit to Mr. Smith after paying freight charges of \$127.48 and taking his commission. The amount Mr. Smith received is called the *net proceeds.*

2. A commission merchant sold 275 barrels of apples at \$4.75 a barrel. His commission was 4%, freight was \$76.49, and drayage, \$4.75. What were the net proceeds?

3. Mr. Andrews, a commission merchant, bought 500 baskets of potatoes for \$.80 a basket. He then sold them in Toronto for \$520. He paid the agent in Toronto a commission of 2%, freight charges of \$46.24, and was given a check for the net proceeds. What were the net proceeds of the transaction? the net profits?

4. Find the commission and net proceeds of each of the following:

	Sale	Rate of Commission		Sale	Rate of Commission	Other Charges
a.	\$400	3%	*g.*	\$3,760	$\frac{1}{2}\%$	\$16.50
b.	\$475	4%	*h.*	\$2,645	25%	\$7.40
c.	\$800	$1\frac{1}{2}\%$	*i.*	\$4,000	10%	\$95.20
d.	\$576	20%	*j.*	\$1,750	$66\frac{2}{3}\%$	\$86.50
e.	\$2,500	$2\frac{1}{2}\%$	*k.*	\$2,750	8%	\$4.20
f.	\$1,250	6%	*l.*	\$7,500	75%	\$165.48

COMMISSION PROBLEMS

A commission problem involves three items; the total sales, the rate of commission, and the commission received. If you know two of these items you can find the third. Study these three problems carefully.

1. A salesman's commission is 5%. How much is his commission on $1,000?

Think: 5% of $1,000 = ?

2. A salesman received a commission of $50 for selling a $1,000 automobile. What per cent was his commission?

Think: $50 = ?% of $1,000.

3. A salesman received a commission of $50 on a shipment of wheat. If his rate of commission was 5% how much were the total sales?

Think: $50 = 5% of the total sales.
$50 = 5% of ?

Find the missing numbers in the table below:

	Total Sales	Rate	Commission	Net Proceeds
4.	$2,000	4%	?	?
5.	$3,000	?	$180	?
6.	$2,500	?	$125	?
7.	$3,600	?	?	$3,456
8.	$4,000	?	?	$3,600
9.	$1,260	4%	?	?
10.	$1,880	?	$188	?
11.	$1,640	?	?	$1,312
12.	?	?	$200	$3,800
13.	?	?	$750	$2,250
14.	?	5%	$ 80	?
15.	?	6%	$ 90	?
16.	?	20%	$720	?

CUMULATIVE TEST I

You should be able to work all of these examples in *fifteen minutes.*

	(3)		(25)		(3)		(25)
1.	837 965 658 589 776	**3.**	78.5 9.6 54.97 216.5	**5.**	59,846 −38,759	**7.**	87.95 −46.983
	(3)		(3)		(3)		(27)
2.	985 ×37	**4.**	649 ×85	**6.**	96)19,860	**8.**	59)28.084

9. $6\frac{1}{2} + 9\frac{1}{4} + 9\frac{3}{8} =$ (*12*) **11.** $87\frac{1}{4} - 28\frac{4}{5} =$ (*14*)

10. Multiply $9\frac{2}{7}$ by $4\frac{1}{5}$ (*17*) **12.** Divide $37\frac{1}{2}$ by $62\frac{1}{2}$ (*19*)

13. Find the sum of 9.85, 6.58, 4.79, and 8.076. (*25*)

14. Subtract 572.3 from 9,602. (*25*)

15. 8,798.51 ÷ 438 = (*27*) **18.** 25% of 48 = (*34*)

16. 85.7 × 4.69 = (*26*) **19.** 36 × $4\frac{1}{2}$ = (*17*)

17. $7\frac{1}{4} \div 5 =$ (*19*) **20.** 16 = ? % of 320 (*35*)

21. Use a short-cut method to multiply 60 by 25; by 50; by $33\frac{1}{3}$; by $12\frac{1}{2}$. (*31*)

22. 8 per cent of what number is 16? (*35*)

23. Express as decimals: $\frac{1}{2}$; $\frac{3}{4}$; $\frac{7}{8}$. (*25*)

24. Express as decimals: 6%; $2\frac{1}{2}$%; 120%. (*28*)

25. 15% of ? = \$4.65. (*35*)

If you have difficulty with any of these examples, practise similar examples in the practice exercises in this chapter as shown by the numbers in italics. Do not be satisfied until you can work correctly and easily all of the kinds of examples contained in the test.

RETAIL PRICE CHANGES

A cut-price sale. **1.** At a "ten-per-cent-off" sale Harry bought a pair of skates for \$3.15. What was the regular price of the skates?

Think: 10 per cent less than the regular price is equal to 90% of the regular price.

90% of ? = \$3.15

2. At a "10%-off" sale Mary bought a dress for \$8.10. What was the regular price?

3. Copy and complete the following table.

Article	Sale Price	Per Cent Off	Regular Price	Reduction
Shoes	\$4.50	10	?	?
Hat	3.40	15	?	?
Bicycle	12.00	25	?	?
Toilet set	2.40	20	?	?

4. A tool chest, regularly priced at \$16, was sold for \$12. What was the per cent reduction?

5. Mrs. Johnson bought $2\frac{1}{2}$ yards of calico at 30¢ a yard, $3\frac{3}{4}$ yards of ribbon at 15¢ a yard, and $4\frac{1}{2}$ yards of gingham at 32¢ a yard. These prices were 25% less than the regular prices. How much did she save?

6. At a sale, boys' suits were priced at $\frac{1}{3}$ off. Henry bought a suit for \$20. What was the regular price of this suit?

7. At a sale, Mary paid 15¢ for a handkerchief, regularly priced at 20¢. Express the reduction as a fraction and as a per cent.

PROBLEM SCALE I

1. If you agree to pay 25% of the expenses of a trip and the expenses are \$64, how much must you pay?

2. A schoolroom should have 15 square feet of floor space for each pupil. How many pupils will a room 24 feet by 35 feet accommodate under these conditions?

3. At 40 cents a pound for candy and 5 cents each for boxes, what is the cost of 6 half-pound boxes of candy?

4. A contractor ordered 5 kegs of nails, 50 pounds to a keg. The cost was $4\frac{1}{2}$ cents a pound, less 10% for cash. Find the net cost for cash.

5. In the month of June, I used 15 kw. h. of electricity at 12 cents a kw. h. I am allowed 4% reduction on the bill if paid before the 10th of the following month. How much was my bill if I paid it on July 8?

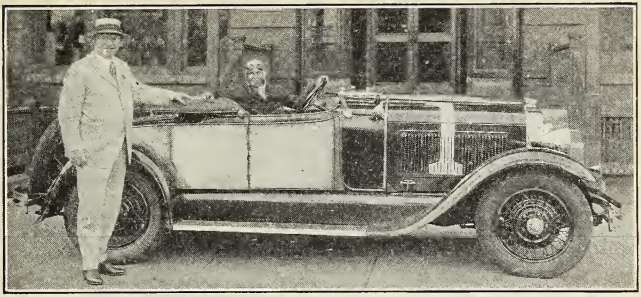
6. Allowing $1\frac{1}{4}$ cubic feet to a bushel, how many bushels of potatoes may be stored in a bin 8 feet by 6 feet by 10 feet?

7. Mr. Brown earns \$175 a month. During the year he spends for rent \$480; for heat and light \$85.75; for food \$675.80; for clothing \$168.70; for insurance \$54.75; for other expenses \$250. What per cent of his income does he save?

8. A line $\frac{1}{4}$ of an inch long on a map in Lucy's book represents 5 miles. What area is represented on the map by a rectangle $1\frac{3}{4}$ inches by $1\frac{1}{4}$ inches?

9. A $5\frac{1}{2}$-pound chicken weighed $3\frac{3}{4}$ pounds when dressed. What was the per cent of waste?

10. Mr. Andrews carried \$10,000 life insurance. His yearly premium was \$202.74. He died after he had paid 25 yearly premiums. How much more than the total premiums he paid did his estate receive?



This automobile was driven 30,000 miles in 26,326 consecutive minutes.

SECTION II

*THE COST OF RUNNING AN AUTOMOBILE

Mr. Andrews kept a careful record of all the expenses of running his automobile. At the end of the year he made some calculations to find how much it cost him for a month, for a day, for a mile. Copy this table.

Item	Year	Month	Day
Gasoline.....	$148.26	?	?
Oil.....	12.70	?	?
Repairs.....	24.65	?	?
Garage rent.....	84.00	?	?
New equipment.	64.72	?	?
License.....	29.70	?	?
Insurance.....	58.65	?	?
Total.....	?	?	?

1. What was the total cost of running the car for the year?

2. How much was spent for gasoline a month?

3. On the average, how much was spent for gasoline a day? Count 30 days as a month.

4. Find the average cost a month for each of the remaining items.

5. Find the total of these monthly costs. Is your total equal to one twelfth of the total cost for the year? If not, how do you account for the difference?

6. Find the average cost a day for each of the other items.

7. Find the total average cost of running the car for one day. Is your total cost for a day equal to one thirtieth of the cost for a month?

8. Mr. Andrews drove the car 9,200 miles. What was the average cost a mile? Find the cost to tenths of a cent.

9. Which costs more, a 25-mile ride on a railway train at 3.6 cents a mile or a ride for the same distance in Mr. Andrews' car?

10. If Mr. Andrews had deposited in the bank at 4% interest for the year the $1,150 which he spent for the car, how much interest would he have received? Is it correct to include interest on the investment as a part of the running expense of an automobile? Explain.

11. Mr. Andrews estimated that his car was worth only $900 at the end of the year because it had been used. Give some reasons why an article becomes less valuable after it has been used for a time. The loss in value because of age and use is called *depreciation.*

12. Counting interest on his money, depreciation, and all his other expenses, what was the total cost of the automobile for the year?

13. How much does it cost Mr. Andrews, at the rate a mile found in problem **8,** to take a hundred-mile trip? a four-mile trip?

***14.** Prepare a form like the one on page 43 and use it to keep a record of the expenses of operating an automobile.

***15.** Explain why railroad fare is less per mile than the cost per mile of running an automobile.

HOW TO BUY HONEY

In the retail stores of a large city it was found that strained honey was sold in 36 different sizes and kinds of containers.

1. Much honey was sold in 5-pound tin pails for $1.15 a pail. How much was this a pound?

2. At the same store many people bought attractive 2-ounce glasses of honey which sold for $.15 a glass. How much did a pound of honey sold in 2-ounce glasses cost?

3. How many times the price a pound in the 5-pound pails was the price of honey sold in the 2-ounce glass containers?

4. A very plain 5-ounce glass jar also sold for 15 cents. What fraction of a pound is 5 ounces? How much is the price of a pound of honey bought in 5-ounce jars?

5. Honey is sold in tins and also glass jars at 28 cents each. The tin contains one pound of honey and the glass jar fourteen ounces. How much more a pound is paid for honey in glass jars than is paid for honey in tin cans?

***6.** Why do you suppose people purchase honey put up in small glass jars instead of pails? Which is the cheaper form of container, a glass jar or a tin pail? Which would look the more bulky, a glass jar or a tin pail containing the same weight of honey?

***7.** What are the two things as given in these problems that seem to influence the cost of honey.

***8.** Do you think it would be wise for the Canadian government to make some regulations about containers and prices?

THRIFT IN BUYING

Saving money by buying wholesale. People who work together in the same establishment often buy goods directly from the wholesaler. In this way they save money. The table below gives the wholesale prices and the retail prices of some foods. A comparison of the two prices will show how much may be saved in this way.

Article	Wholesale	Retail	Difference	Per Cent Saved
Sugar, lb.....	$.045	$.07	..	..
Butter, lb.....	.387	.55	..	..
Wheat flour, lb.....	.048	.06	..	..
Evaporated milk, can...	.086	.12	..	..
Potatoes, lb.....	.014	.028	..	..

1. What is the difference between the wholesale price and the retail price for each article of food?

2. What per cent of the retail price is this difference?

3. How much less does 100 pounds of sugar cost at the wholesale price than at the retail price?

4. How much is saved by buying a barrel of flour at the wholesale price? (*1 bbl. flour = 196 lb.*)

5. One group of people bought 100 pounds of butter from a creamery in the city at $.475 a pound. The retail price was $.52 a pound. How much did the group save by buying butter wholesale?

6. What per cent of the retail price of the butter is this?

Saving money by buying in bulk. A comparison of prices of food bought in bulk and in packages shows that a big saving can be made by buying in bulk.

Kinds of Food	Price a Pound (bulk)	Price a Pound (package)	Increase of Package over Bulk	Per Cent Increase
Graham flour	9.5¢	10.0¢	.5¢	5.3
Rye flour	7.5	9.0	..	...
Corn meal	6.5	10.0	..	...
Oatmeal	10.0	10.4	..	...
Rolled oats	5.25	8.0	..	...
Macaroni	6.25	16.0	..	...
Soda crackers	22.0	30.0	..	...
Oyster crackers	20.0	30.0	..	...
Shredded coconut	30.0	50.0	..	...
Tapioca	15.0	25.0	..	...
Average	....	....	..	...

1. Find the increase of the price a pound in package over the price a pound in bulk for each item.

2. What per cent of the price in bulk was each increase of package over bulk?

3. What was the average per cent of increase?

4. What was the smallest per cent of increase? the largest per cent of increase?

***5.** Find the package price and the bulk price of different kinds of food sold in local stores. What savings are possible?

***6.** In a recent year it was found that the cost of the package was 38% of the cost of producing canned corn, while the farmer received only 32% of the total cost for the corn itself. Name some food packages that you think are more expensive than is necessary.

BUYING ON THE INSTALMENT PLAN

Mrs. Andrews was planning to buy a vacuum cleaner which was advertised for $80 cash, or for $87.50 on the instalment plan—$3.50 down, and the balance in twelve monthly payments of $7.00 each. Her problem was to decide whether to pay cash or to make monthly payments.

Mrs. Andrews prepared a table like the one below, showing the actual length of time she paid interest on each payment, and the total time she paid interest.

$7.00 for 1 mo.
7.00 for 2 mo.
7.00 for 3 mo.
7.00 for 4 mo.
7.00 for 5 mo.
7.00 for 6 mo.
7.00 for 7 mo.
7.00 for 8 mo.
7.00 for 9 mo.
7.00 for 10 mo.
7.00 for 11 mo.
7.00 for 12 mo.
$7.00 for 78 months in all.

Since instalments were to be paid each month, interest should really be paid on the first payment of $7.00 for only one month. At this rate interest would be paid on $7.00 for 78 months.

The interest on $7.00 for 1 mo. at 6% is $.035.

The interest on $7.00 for 78 mo. at 6% is $2.73.

1. This interest amounts to how much more or less than the $7.50, the difference between the cash and instalment payment plans?

2. The interest, $7.50, is how many times as much as it would be at 6%? Carry your answer to hundredths.

3. At what rate would Mrs. Andrews be paying interest if she bought the vacuum cleaner on the instalment plan?

4. Mr. Smith bought a $1,100 automobile. He made a cash payment of $500 at the time of purchase, and paid the balance in twelve monthly instalments of $55.58

each. What was the difference between the cash price and the amount that Mr. Smith paid?

5. Prepare a statement like the one at the beginning of this exercise, showing the amount of interest on his payments at the rate of 6%.

6. How much more than this amount did Mr. Smith actually pay?

7. The interest Mr. Smith actually paid was how many times as much as it would be at 6%?

8. What rate of interest did Mr. Smith pay on the time payment plan?

9. Mrs. Jaska made 12 monthly payments of $10 each on an electric sewing machine which sold for $105 cash. She paid interest at how many times a 6% rate?

***10.** Is any member of your family now paying for some article on the instalment, or deferred payment, plan? Get the necessary facts and compute the interest rate.

***11** Find an advertisement which offers an article on the instalment plan. Compute the interest rate.

***12.** What would be a fairer method of fixing the selling price on the instalment plan than the methods that have here been described?

***13.** Discuss with your parents and others the advantages and disadvantages of buying on the instalment plan. Name some articles often sold on the instalment plan.

PAYING FOR A HOUSE

In order to pay for his new house, Mr. MacDonald borrowed \$5,000. He agreed to pay back \$50 a month plus interest on unpaid balances at the rate of 6% a year.

1. At the end of the first month Mr. MacDonald paid \$50 plus the interest on \$5,000 for 1 month at 6%. How much interest did he pay? Count 1 month as $\frac{1}{12}$ of a year. What was the amount he paid at the end of the first month?

2. How much did Mr. McDonald still owe on his house?

3. The second month Mr. MacDonald again paid \$50 plus the interest for 1 month on \$4,950. At 6%, the interest on \$4,950 for 1 month is ——. His total payment was ——.

4. What was the amount Mr. MacDonald still owed on his house? This would be the amount on which he must pay interest at the end of the third month.

5. Find the interest Mr. MacDonald paid at the end of the third month. Compare the interest at the end of the third month with the interest at the end of the first month. Does the interest which Mr. MacDonald paid increase or decrease each month?

6. Make a table showing the interest and total payments for each of the twelve months during the first year. Include in your table the principal on which Mr. MacDonald pays interest at the end of each month.

7. What will be the principal on which Mr. MacDonald will pay interest after 40 payments?

8. How many payments must Mr. MacDonald make to pay off the entire debt?

9. What will be the total of the 50th payment?

10. How much less than on the first payment is the interest on the 50th payment?

BUYING A HOUSE IN MONTHLY INSTALMENTS

Mr. Helms bought a house for $7,000. He agreed to pay off the loan in monthly instalments of $75. Each instalment was to include interest at 6% a year on the amount he still owed, as well as payment to reduce the principal.

1. How much was the interest for the first month on the $7,000 which Mr. Helms borrowed?

2. The difference between $75, the total payment, and the interest on the loan is the amount Mr. Helms paid on the house. How much did Mr. Helms owe at the end of the first month?

3. At the end of the second month, Mr. Helms again paid $75. To find the amount the principal is reduced by this payment, deduct the interest on $6,960, the total amount he owed at the end of the first month, from $75. How much did he reduce the debt by his second payment?

4. Make a table showing the principal at the end of each of the first twelve months, the interest on the principal, and the reduction of the principal.

5. How does the interest at the end of each month compare with the interest for preceding months?

***6.** How does the plan used by Mr. Helms differ from that used by Mr. MacDonald? Which do you prefer?

7. Mr. Scott bought a lot for $750 on a contract to pay $12 a month. Part of this was to be interest on the principal at 6% a year, and the rest was to go toward reducing the amount he still owed on the lot. Make a table showing the principal at the end of each of the first twelve months, the interest on the principal, and the reduction of the principal.

***8.** Find how a mortgage and a deed differ.

LIBRARY OF THE UNIVERSITY

DOES IT PAY TO FATTEN CATTLE?

Many farmers make money by buying steers, sheep, and swine and fattening them before selling them. Below are some records of the cost.

1. Mr. Mauske kept a record of the cost of fattening a steer for 84 days. Make a copy of the record and find the missing numbers:

Cost:

Cost of the steer, weight 1,050 lb. at $5.00 a cwt.	?
Cost of 1,680 lb. corn at 52¢ a bu. (56 lb. a bu.)	?
Cost of 640 lb. corn stover at $4.00 a ton	?
Cost of 570 lb. alfalfa at $7.00 a ton	?
Risk, labour, and shelter	$5.00
Total cost	?

Receipts and credit:

Selling price 1,274 lb. at $6.05 a cwt.	?
Credit for fertilizer	$5.00
Total receipts and credits	?
Profit (Selling price—total cost)	?

2. If Mr. Mauske had sold the steer at $5.00 a cwt., would he have made a profit?

3. What was the steer's average daily increase in weight?

4. How many pounds (1) of corn, (2) of corn stover, (3) of alfalfa, did it take to produce an increase of one pound in weight?

5. Below is a record of the cost of fattening a lamb, 96 days' feeding. Copy and record neatly and find the missing items:

Cost of 50 lb. lamb at $6.00 a cwt	?
Cost of 134 lb. corn at 40¢ a bu	?
Cost of 125 lb. clover hay at $12 a ton	?

Risk, labour, and shelter	$.50
Total cost	?
Selling price 74 lb. lamb at $7.50 a cwt	?
Profit	?

6. How much would be the profit on 500 lambs at the rate above? Would it pay to fatten only a few lambs?

7. How much did the weight of the lamb increase in the 96 days? What was the average increase in weight a day? How many pounds of corn were required for each pound of increase in weight of the lamb? How many pounds of clover hay?

8. Below is a record of the cost of fattening a hog for 60 days. Copy the record neatly and find the missing items.

Cost of 115 lb. hog at $5.20 a cwt	?
Cost of 220 lb. of cornmeal at $18 a ton	?
Cost of 220 lb. of middlings at $25 a ton	?
Risk, labour, and shelter	$.75
Total cost	?
Selling price, 240 lb. hog at $5.25 a cwt	?
Profit	?

9. How many pounds on the average did this hog increase in weight each day?

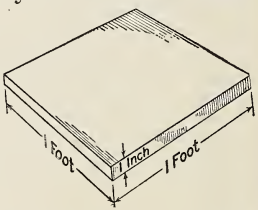
10. How many pounds of cornmeal were used in producing an increase of one pound in the weight of the hog?

***11.** At the rates above about how many lambs must be fattened and sold to yield a profit equal to the profit from one hog? from one steer?

***12.** What is meant by the item for each kind of animal, "risk, labour, and shelter"? Why is this item less for a sheep than for a steer?

HOW LUMBER IS MEASURED

Fred wished to build some shelves for books in his study. He first drew a plan of the shelves. Then he found the length of the shelves and the length of the sides. He estimated that he would need 4 boards 1 inch thick, 10 inches wide, and 10 feet long. At the lumber-yard he learned that he could buy the kind of lumber he wished for \$30 a thousand, or M, board feet. How much would the lumber for the shelves cost? To find the cost you must learn how lumber is measured.



Lumber is usually measured by the *board foot.* A board foot equals a board 1 foot long, 1 foot wide, and 1 inch thick. A board of ordinary lumber less than an inch thick is measured as if it were an inch thick.

To find the number of board feet in a piece of lumber, *multiply the length in feet by the width in inches by the thickness in inches, and divide the result by 12.*

1. How many board feet are there in a plank 10 feet long, 8 inches wide, and 3 inches thick?

$$\textit{Think: } \frac{10 \times \cancel{8}^{2} \times \cancel{3}}{\cancel{12}_{\cancel{3}}} = ?$$

2. Find the number of board feet in a board 10 feet long, 10 inches wide, and 1 inch thick (usually written $1'' \times 10'' \times 10'$).

3. Find the number of board feet of lumber Fred needed.

4. What was the cost of the lumber Fred needed?

5. Find the cost of three boards, $2'' \times 8'' \times 10'$, at \$25 a M.

DOES A WOOD LOT PAY?

One of the great problems in North America is the preservation of the forests now standing and the reforestation of cut-over lands.

Mr. Andrews owns 40 acres of hard-wood land. It is very uneven and sloping. The land had been untouched for about 20 years and had a fairly good stand of timber.

1. One year after he bought the land Mr. Andrews cut an average of 4,500 board feet an acre. How much was the total yield? in M board feet?

2. Of this yield two thirds was in the form of ties and the rest in saw logs. How many board feet were there in the ties? How many M board feet were in the saw logs?

3. He received $28 a M board feet for the ties and $9.00 a M feet for the saw logs. How much did he receive in all?

4. Nine years later he made another cutting, averaging 2,000 board feet an acre, half in ties and half in saw logs. He sold the ties at $30 a M feet and the saw logs at $9.50 a M feet. How much was received at this cutting?

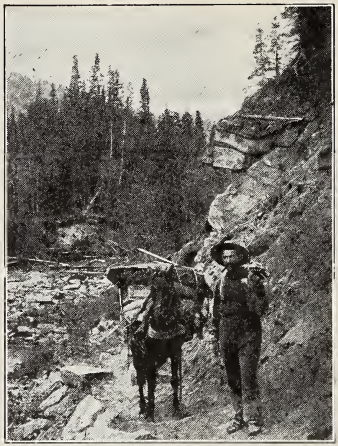
5. These cuttings composed the entire product in 10 years. Find the average yearly value of the yield an acre?

6. How much more was this than he would have received if he had cleared the land and raised wheat on it, 14 bushels to the acre, sold at $.87 a bushel?

7. Mr. Andrews estimates 228 trees an acre still standing. 30 per cent are 10- to 14-inch trees and the rest 4- to 10-inch. Find the total number of trees left.

8. How many 10- to 14-inch trees are there? How many 4- to 10-inch trees? Can you find a 10-inch tree in your neighbourhood?

GOLD IN CANADA



As Canada is second among the nations of the world in the production of gold, Canadian young people should know facts regarding this metal.

1. Canada produces 12 per cent of the world's supply of gold. In a recent year the Dominion produced in round numbers 2,964,000 ounces of gold. About how many ounces were produced in the world that year?

2. For many years the standard value of gold in Canada and the United States was $20.67 per ounce. At this standard price what was the value of Canada's gold production that year?

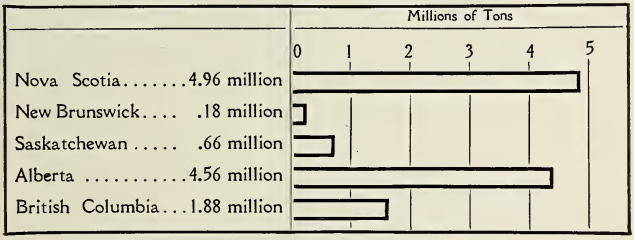
3. In the year 1934 the selling value of gold in Canadian currency was $33.47. During that year Ontario mines produced gold at the rate of $170,000 a day in Canadian money. How many ounces a day were produced in the gold mines of Ontario?

4. Before the changes brought about after the suspension of gold payments in 1933 the Canadian gold dollar weighed 25.8 grains, nine tenths pure gold. How many ounces of pure gold were in the Canadian gold dollar?

5. Find the value of a grain of gold (*a*) when an ounce was worth $20.67, (*b*) when an ounce was worth $33.47.

PRODUCTION OF COAL

1. During a recent year, the total coal production of Canada amounted to 14,881,324 tons. If, on the average, a carload of coal equals 53.47 tons, how many carloads of coal were produced that year in Canada?



2. This graph shows the total production of coal in millions of tons in five of the provinces of Canada in a recent year. What was the total coal production in these five provinces together in millions of tons?

3. How many times the coal production of New Brunswick was the production of British Columbia?

4. Express the total amount of coal produced that year, as given in problem **1**, in millions, correct to two decimal places. How much coal was produced in provinces other than the five given in the graph above?

5. How much more than in New Brunswick was produced in Alberta?

***6.** What is the retail price of a good grade of bituminous coal in the community in which you live? Where is it produced? Find if possible the price of this coal at the mouth of the pit in which it was mined? What is the price of a carload of this coal at the pit price? at the retail price?

HOW MUCH DO PEOPLE EARN

The figures below give the average annual earnings of workers in important occupational groups for a recent year.

Occupational Group	Average Earnings	Occupational Group	Average Earnings
Agriculture	$ 319	Manufacturing	$1,038
Construction	709	Mining	903
Electric light and power	1,489	Service (Professional, etc.)	1,176
Finance	1,730	Trade	1,150
Forestry	486	Transportation and Communication	1,171
Others	1,094		

1. Name types of workers who would be included in the various occupational groups given above.

2. List these groups, arranged in the order of the size of annual earnings, with the largest earnings group first.

3. Find the average monthly earnings of each group to the nearest dollar. For example, those engaged in agriculture earned $\frac{1}{12}$ of $319 a month, or $\$26\frac{7}{12}$. To the nearest dollar this was $27. Count a half as the next higher dollar. List these facts after the names.

4. During the year shown in the table, workers in automobile factories earned on the average $1,422. How much more was this than the average of the manufacturing group?

5. That year workers in cotton yarn and cloth factories earned $771. How much less a month was this than the amount earned by automobile workers?

***6.** Discuss reason for differences in the earnings of the above groups of workers. For which group are earnings likely to be most certain? least certain? Why?

PAYING PEOPLE FOR THE WORK THEY DO

There are two main methods of paying the wage-earner for the work he does. The first is called "time payments"; the second is called "payment by results." Under the time-payment plan, the worker's wages depend upon the time he spends on his employer's business. Under the "payment-by-results" plan, the worker is paid according to the amount he produces. Sometimes these plans are combined in various ways and the worker is paid both according to time and amount.

How the "Time-payment" Plan Works:

1. In one large eastern city carpenters are paid $1.00 an hour for an 8-hour day. How much do they receive for 5 day's work?

2. For working more than 8 hours a day they are paid "double time" for overtime work. How much would a carpenter receive for working 10 hours in one day?

3. In another city plasterers are paid $1.50 an hour for a 7-hour day and "time and a third" for overtime. Under this plan how much does a plasterer receive who works $9\frac{1}{2}$ hours in one day?

4. In a certain city labourers received $2.60 for an 8-hour day. How much did they receive for a 40-hour week?

5. Girls in a certain department store received $12.40 a week for 40 hours work. How much did they receive for an hour?

***6.** In that city all ordinary labourers, employed by one firm, regardless of differences in their strength and the amount of work they did, were paid the same wages for an hour's work. Is this system a fair one?

How the "Payment-for-results" Plan Works.

1. In St. Catharines, Ontario, a farmer paid workers $2\frac{1}{4}$ cents a basket for picking grapes. John averaged 170 baskets a day. Arthur picked only 130 baskets. How much more than Arthur did John receive for a day's work?

2. Harold and Fred sold 10-cent magazines for which they paid the dealer $6\frac{1}{2}$ cents. One week Harold sold 40 magazines and Fred sold 28. How much less than Harold did Fred earn?

3. A barber paid his helper 25¢ of the 50¢ received for a haircut, 15¢ of the 25¢ received for a shave, 30¢ of the 50¢ received for a shampoo, and one half of all other money received for work done. One week the helper was paid for 52 haircuts, 60 shaves, 45 shampoos, and his share of the $6.20 received for other work he did. How much did the helper receive? How much did the barber receive?

4. One clothing merchant pays his salespeople one tenth of all money taken in from their sales. Below are given the sales for a week by two salesmen. How much did each one earn each day? during the week?

	Mr. Bowen	Mr. Bartley
Monday	$25.00	$50.00
Tuesday	18.50	46.75
Wednesday	39.25	60.25
Thursday	16.75	97.50
Friday	40.00	130.25
Saturday	55.50	225.00

*5. Workers in many kinds of factories are paid "by the piece." Can you find examples in local factories of how people are paid for the results of their work? Miners are often paid according to the amount of coal they produce.

COMBINING THE TWO PLANS

In many concerns the two plans of payment discussed on pages 59 and 60 are combined in various ways.

1. In one barber shop, each barber is guaranteed at least $18 a week. In addition to this amount he is paid one half of all money taken in for his work above $30. How much could a barber receive in this barber shop if his receipts for three weeks were $28? $30? $52?

2. One farmer offered to pay persons who picked his raspberries $.40 a crate or $2.00 a day. One worker on the day rate picked only 4 crates. How much more did he receive than he would have received if he had been paid by the crate?

3. Another worker picked 8 crates of berries. How much more did he receive when paid by the crate than he would have received if paid by the day? Would you cut the rate of pay for this worker if you were the farmer?

4. A clothing merchant agreed to pay his salespeople $18 a week and one tenth of all sales over $300. This is called a "bonus" plan. One clerk had sales during the week amounting to $270. Another had sales amounting to $520. How much more did the second clerk receive than the first clerk? Why shouldn't both clerks be paid the same amount?

5. An automobile dealer paid each of his salesmen $20 a week and in addition one twentieth of the money received for the cars each one sold. According to this plan how much would a salesman receive who sold 3 sedans at $925 each, a truck for $575, and 2 roadsters at $620 each?

***6.** Try to find examples of ways like those described above in which people in your locality are paid.

BALANCING CASH ACCOUNTS

Boys and girls should learn to keep an account of all the money they receive and pay out. Such an account is called a *cash account.* At the end of the month cash accounts should be *balanced.*

Study carefully the following cash account which was kept by Harry Wilson for the month of August:

RECEIVED					PAID OUT				
19—					19—				
Aug.	1	On hand	5	30	Aug.	4	Ticket, ball game		25
	9	Allowance	2	50		11	Picnic expenses		54
	16	Mowing lawn	1	25		19	Baseball	1	25
	18	Caddying		90		23	Cap		90
	24	Errands		75		26	Gift for Tom	1	00
	27	Caddying		50		31	Balance		?
				?					?
Sept.	1	On hand		?					

1. Balance the account as follows:

a. Find how much Harry paid out in August.

b. Find the amount of cash on hand at the beginning of the month and the money received during the month.

c. The difference between these sums should equal the amount that Harry had left at the end of the month, or the balance. Harry had $7.26 left at the end of the month. Does this check with his account? If it does, we say that the account *balances.*

2. What amount will Harry write as *Cash on hand* on September 1?

3. Keep a personal cash account for one week.

PRACTICE TESTS IN FRACTIONS—I

You should be able to work all of these examples correctly in less than *eight minutes.*

1. $3\frac{2}{3} + 2\frac{1}{6}$
2. $9 - \frac{1}{2}$
3. $\frac{1}{2} \times \frac{7}{10}$
4. $\frac{1}{3} + \frac{1}{5} + \frac{3}{10}$
5. $5 \div \frac{2}{3}$
6. $6 \times 3\frac{3}{4}$
7. $\frac{1}{9} \div \frac{1}{3}$
8. $3\frac{5}{6} - 1\frac{2}{3}$
9. $1\frac{1}{2} \div \frac{1}{2}$
10. $\frac{5}{8} \times 6\frac{2}{5}$
11. $3\frac{1}{4} - \frac{11}{12}$
12. $1\frac{1}{5} \div 4$
13. $7\frac{1}{6} + 1\frac{3}{5} + 3\frac{1}{6}$
14. $3\frac{3}{4} \times 3\frac{1}{3}$
15. $18 \times 15\frac{3}{4}$

PRACTICE TEST IN DECIMALS—I

You should be able to work all of these examples correctly in less than *eight minutes.*

1. $.4 + .1 + .3 =$
2. $.9 - .275 =$
3. $5 \times .3 =$
4. $.12 \div 4 =$
5. $.05 + .08 + .09 =$
6. $6.75 \div 1.25 =$
7. $27.08 - 15.17 =$
8. $4 \times 2.6 =$
9. $3.26 + .04 + 1.1 =$
10. $10 \div .2 =$
11. $.375 - .21 =$
12. $8.725 \div 25 =$
13. $1.4 \times 32 =$
14. $20 - 3.825 =$
15. $1.21 \div .11 =$
16. $4.8 \times 6.5 =$

PRACTICE TEST IN PER CENTS—I

You should be able to work all of these examples correctly in less than *eight minutes.*

1. $.04 = —\%$
2. $2.375 = —\%$
3. $\frac{9}{10} = —\%$
4. 6% of $80 =$
5. $3 = —\%$ of 10
6. $6 = 25\%$ of —
7. 28% of $72 =$
8. $2 = —\%$ of 40
9. $\$1.40 = 35\%$ of —
10. $120 = —\%$ of 96
11. 125% of $72 =$
12. $12\frac{1}{2}\%$ of — $= 80$
13. $30 = —\%$ of 90
14. 4.5% of $1000 =$
15. 250% of — $= 600$
16. 6% of $720 =$

CUMULATIVE TEST II

You should be able to work all of these examples in *fifteen minutes.*

1. (3) 345, 859, 478, 595, 868

2. (25) 63.7, 8.59, 346.2, 99.7

3. (3) 87,596 − 28,357

4. (25) 596.3 − 54.721

5. 847 (3) × 46

6. 467 (3) × 79

7. $87\overline{)31,146}$ (3)

8. $43\overline{)31,777}$ (3)

9. $6\frac{1}{3} + 5\frac{5}{6} + 3\frac{4}{9} =$ (12)

10. $28\frac{1}{2} - 16\frac{3}{4} =$ (14)

11. Find the product of $6\frac{2}{3}$ and $8\frac{1}{4}$. (17)

12. Divide $62\frac{1}{2}$ by $12\frac{1}{2}$. (19)

13. Find the sum of 8.56, 25.2, 4.175, and 35. (25)

14. Subtract 8.463 from 128.5. (25)

15. 956.984 ÷ 596 = (27)

16. 53.7 × 24.3 = (26)

17. 80 = —% of 64 (35)

18. 5% of 15 = (34)

19. 20% of — = 48 (35)

20. Five tenths is what per cent of four? (35)

21. If the rate is $12\frac{1}{2}\%$ and the discount is \$.48, how much is the original price? (35)

22. If the commission is \$4.50 and the rate is 5%, what are the net proceeds? (39)

23. If the price is \$60 and the discount is 5%, find the reduced price. (33)

24. Express $87\frac{1}{2}\%$ as a common fraction. (31)

25. What is the area of a rectangle 2.5 feet long and 1.4 feet wide? (26)

SECTION III

WHAT GRAPHS TELL US

The drawing at the right shows the effects of elevation on temperature and pressure.

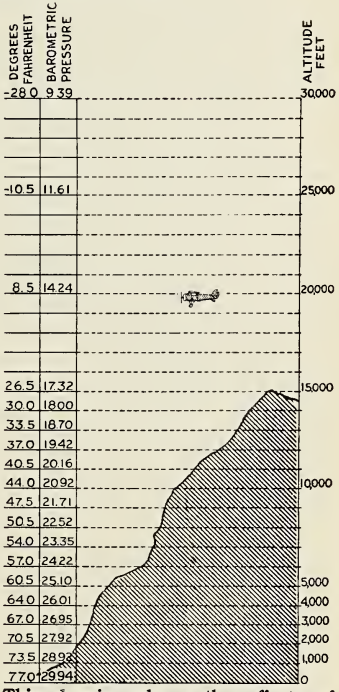
1. Altitude 0 means "sea level." What is the temperature at sea level in this locality? the barometric pressure?

2. What is the temperature at 10,000 feet? at 15,000 feet? at 20,000 feet?

3. What is the barometric pressure at 10,000 feet? at 15,000 feet? at 20,000 feet?

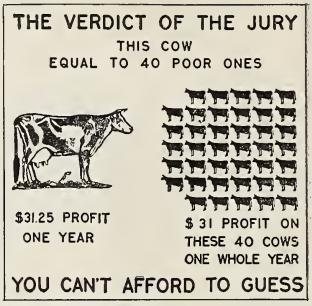
4. Approximately how much cooler is the weather with each 1,000 feet ascent? How much less is the pressure of the air?

5. How much lower is the temperature at 25,000 feet than at 20,000 feet?



This drawing shows the effects of elevation on temperature and pressure.

PICTOGRAMS



Graphs containing pictures are often used to present facts. The pictures help us to remember. Such graphs are called *pictograms.*

1. The pictogram at the right presents the results of a study of the value of testing cows to find out if they are good producers. What does the picture of the large cow at the left of the graph represent? of the small cows?

The pictogram below represents the wheat yield an acre of five countries. The baskets represent the facts given in the table below the graph. Above each basket is given a bar that also represents the yield an acre.

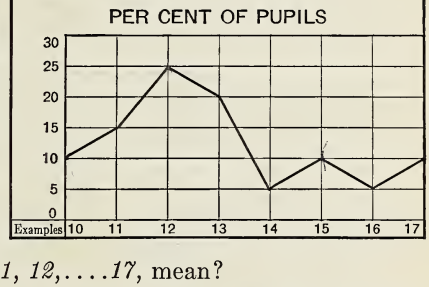
2. How many times as much as the yield in Canada was the yield in Belgium? How many times as long as the line representing the yield in Canada should the line for Belgium be? Do the lines in the graph seem to be correct?

3. Estimate how many times as large as the basket for Canada the basket for Great Britain and Ireland is. Which gives more nearly a correct picture of the facts, the basket or the lines? Without the line graph, the picture would be quite confusing.

A. Belgium.....38.0
B. Germany....34.3
C. Great Britain and Ireland..31.3
D. France.....20.4
E. Canada.....17.1

LINE GRAPH SHOWING PER CENTS

This graph shows the per cent of pupils in a class that made each of the scores indicated on a test containing 20 examples.



1. What do the numbers *10, 11, 12,....17*, mean?

2. What do the numbers *0, 5, 10, 15, 20, 25, 30*, on the scale at the side of the graph mean? What number comes after *30* if the scale is continued?

3. What per cent of the class had 10 examples correct? Use the scale at the left of the graph to tell.

4. What per cent of the class made each of the other scores on the test?

5. What score was made by the largest per cent of the class?

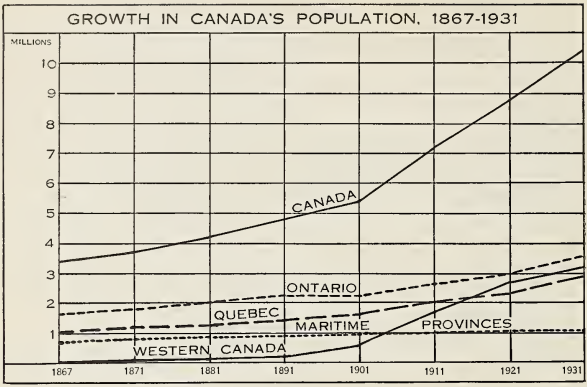
6. Name two scores that were made by the same per cent of the class.

7. If there were 40 pupils in the class, how many pupils made each score?

8. How many pupils had 75% or more of the examples correct? How many had less than 60% correct? What per cent had less than 50% of the examples correct?

9. Collect as many different school graphs as you can for class discussion. Tell what each graph shows.

***10.** Construct a graph similar to the one above from the results of the next spelling test given to your class.



READING A LINE GRAPH

1. What in round numbers was the population of Canada when the Dominion was organized in 1867?

2. In which decade was there the slowest growth in population?

3. In what decade was there the greatest growth?

4. How much was the increase in population in round numbers from 1911 to 1931?

5. State in round numbers the population in 1901.

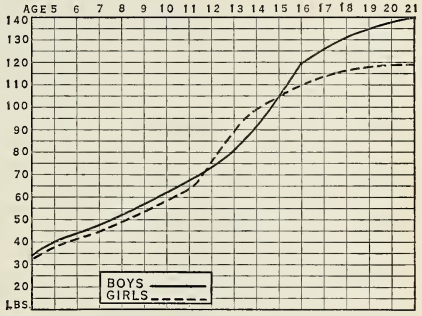
6. What per cent of the population in 1901 was the increase during the following 20 years?

7. In round numbers, estimate the yearly average increase in population from 1867 to 1931.

***8.** Draw a line graph like the above showing the growth of the population of the province in which you live since the year it was admitted into the Dominion. Extend the graph to the present year.

CURVED-LINE GRAPHS

The curved-line graph at the right shows the average weights of boys and girls at each age from 5 to 21 years of age. Why is this type of graph called a *curved-line* graph?



1. Which line shows the weights for boys?

2. Which line shows the weights for girls?

3. Make a table similar to the one below, showing the approximate weights of boys and of girls at each age.

Years	Boys	Girls
5	40	37
6	..	..

4. At what ages do boys weigh more than girls? Use both your table and the graph to find the answer.

5. At what ages do girls weigh more than boys?

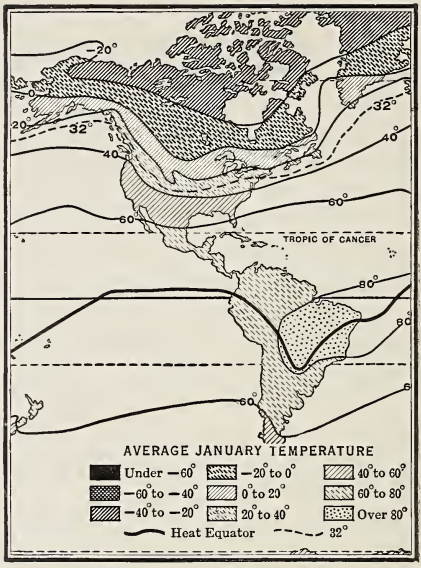
6. Could this graph have been drawn before a table, such as the one you prepared, was available? How may the facts for such a table be secured?

7. From the graph tell how much an average 16-year-old boy weighs; a 15-year-old girl.

*8. Why do you think a curved-line graph was used instead of a broken-line graph?

CARTOGRAMS

Maps like these are often called *cartograms*. They are frequently found in reference books and government reports.



Average temperatures for January.

1. How do cartograms such as this one differ from the dot maps?

2. What information is given in the map that helps you to read it?

3. Name a country shown on the map in which the average temperature in January is under −20°; that is, 20° or more below zero.

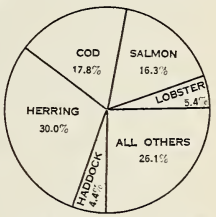
4. Name a country shown on the map in which the average temperature is over 80°, that is, 80° above zero.

5. What is the average January temperature of the Great Lakes region? of British Columbia? of Nova Scotia? of Argentina?

6. Explain the meaning of the small numbers printed on the irregular curved lines. These lines are called *isotherms*. What is remarkable about the isotherm of 32°?

USING GRAPHS TO SHOW PER CENTS

In a recent year the Canadian fishing industry produced 410 thousand tons of products, valued at $25,800,000.



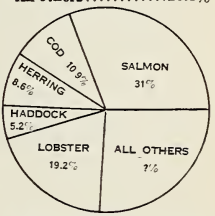
Lobster 5.4%
Salmon 16.3%
Cod 17.8%
Herring 30.0%
Haddock 4.4%
All others 26.1%

1. The circle graph at the right pictures the per cents of the total weight that were lobster, salmon, cod, herring, and haddock.

All other fish are placed in one group. What per cent of the total were the lobster? the salmon? the cod? the herring? the haddock? all others?

2. Find the approximate weight of the salmon to the nearest thousand tons; the cod; the herring; the haddock; all others.

3. The circle graph at the right gives the per cents of the total value of all fish for the kinds of fish included in the circle graph above. Find the total of the per cents given in the graph and find the per cent of the total value that represents the value of all other sea-food producers.



Salmon 31.0%
Cod 10.9%
Herring 8.6%
Haddock 5.2%
Lobster 19.2%
All others ..... ?%

4. Make a table showing the value of each kind of sea food included in the graph.

5. How large should be the central angle in the section of the circle that represents the value of the salmon?

Think: 360° = total of central angles. 31% of 360° = ?

6. Find the number of degrees there should be in each of the other central angles and check both graphs.

OUR FOREST LANDS

1. In all of Canada there are 378,945 square miles of merchantable timber and 412,725 square miles of young growth. Find the total area of timber. Find some province whose area is approximately equal to the area of merchantable timber land.

2. Of all merchantable timber 269,340 square miles are soft woods, 21,575 are hard woods, and the rest is mixed. About how many times as many square miles of hard woods are there of soft woods?

3. Make a circle graph picturing the kinds of timber listed in problem **2**.

4. In a recent year Canada produced 2,227,000 tons of newsprint. That year the whole world produced 6,622,000 tons of newsprint. What per cent of the total world supply did Canada produce?

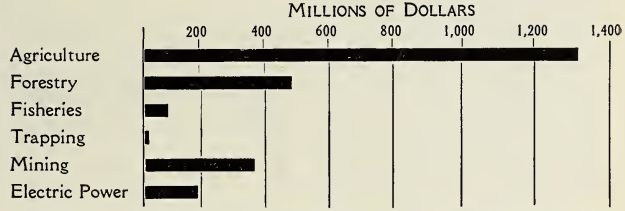
5. It is estimated that the total annual consumption of wood in Canada is as follows:

2,000 million cubic feet of conifers.
970 million cubic feet of hard wood.
185 million cubic feet lost by fire—conifers.
45 million cubic feet lost by fire—hard woods.
700 million cubic feet lost by insects and disease.

Find the total annual consumption.

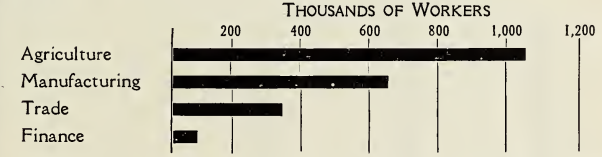
PICTURING LARGE NUMBERS

1. The graph below pictures the value of primary products of Canada for a recent year.



Estimate the value of each kind of product. Then find the approximate total value of these products.

2. The graph below pictures the number of workers engaged in four occupational groups in a recent year.



Estimate the approximate number of workers in each occupational group and the total number in the four groups.

3. Construct a graph like the one above picturing the number of workers engaged in the following groups:

Construction	256,091	Service	766,256
Transportation	306,209	Mining	72,011

4. Make graphs picturing the following facts about wheat. Make a graph for each set of data.

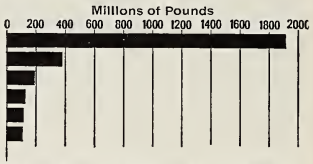
YEAR	PRODUCTION	EXPORTS	ACREAGE
1871	17,000,000 bu.	2,000,000 bu.	1,600,000 a.
1901	56,000,000 bu.	10,000,000 bu.	4,200,000 a.
1931	321,000,000 bu.	217,000,000 bu.	26,200,000 a.

INTERPRETING BAR GRAPHS

1. The bar graph below pictures the amount of coffee exported by the six leading coffee-exporting countries.

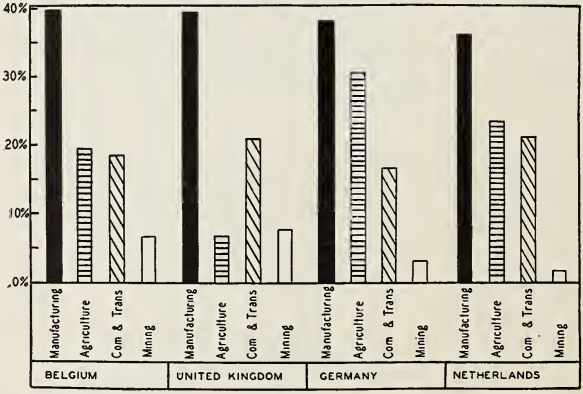
Make a table showing the amounts of coffee exported by each country, to the nearest 100 million pounds.

2. Make a copy of the graph to a scale twice as large as the scale shown at the right.



The leading coffee-exporting countries of the world.

Sometimes a graph contains bars that picture different kinds of information. The graph below pictures the percentages of gainfully employed persons in four countries.



3. What percentage of workers were engaged in manufacturing in each of the countries? agriculture? mining?

***4.** Look up similar data for Canada and draw a graph.

*PROBLEMS OF THE CATTLEMAN

The cattleman ships cattle to market throughout the year. What is the best time of the year for the cattleman to market his cattle? This table, giving certain facts for a recent year, will help you to answer this and other questions.

A champion dairy cow

Month	Cattle		Calves		Swine	
	Average Weight	Price a 100 lb.	Average Weight	Price a 100 lb.	Average Weight	Price a 100 lb.
January.....	965.9	$6.65	176.8	$8.29	217.1	$7.09
March.....	967.2	7.14	152.0	8.85	222.6	7.19
May.....	948.3	7.92	157.4	8.19	224.3	7.26
July.....	940.3	7.19	181.4	7.61	237.2	7.60
September....	938.5	6.33	201.4	7.23	232.2	9.63
November.....	932.8	5.34	197.6	6.24	211.6	9.01

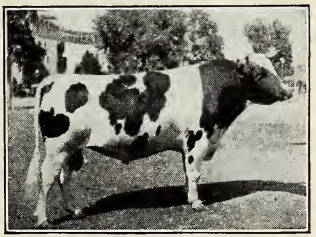
1. In what month was the average weight of cattle greatest? of calves? of swine?

2. Find the difference in weight for each class of live stock in the months of greatest and least average weight.

3. In what months were the prices highest? lowest?

4. Did the prices of any of these classes of live stock increase from month to month? Did any decrease?

5. Find the average weight for each class of live stock for the year.



A fine specimen of beef cattle

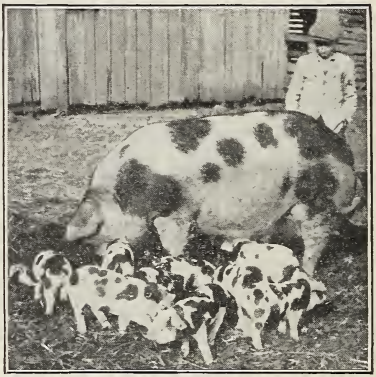
6. Find the average price a 100 pounds for the year for each class of live stock.

*7. How much did the stockman receive for a July shipment of 30 cattle, 15 calves, and 100 swine of average weight?

*8. Using the January cost of pork as 100%, what per cent of the January price is the price for each month?

*9. Make a list of as many reasons as you can for the differences from time to time in the prices and weights of live stock.

*10. Find current prices for cattle, calves, and hogs at stockyards. Are the prices higher or lower than given in the table?

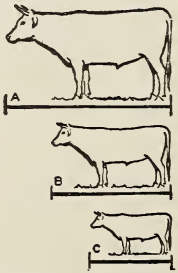


This sow and litter of little pigs belongs to the boy in the picture. He is a member of a pig club.

*11. What time of the year can the cattleman sell cattle at greatest profit? Give your reasons.

*12. Draw a line graph showing how the average weight of cattle varies from month to month during the year. Draw similar graphs for calves and swine.

*13. The graph at the right is a picture of the relative number of cattle in three countries. If country *C* has 60,000,000 cattle, approximately how many cattle are in country *B*? country *A*?



PRACTICE TESTS

Practise each set of examples until you can work all of the examples correctly in the time allowed. Keep a record of your scores in each practice test. Try to better the score you made in the first practice tests.

PRACTICE TEST IN FRACTIONS II (8 minutes)

1. $\frac{5}{9} \times \frac{3}{7}$
2. $3 - 1\frac{2}{3}$
3. $12 \div \frac{3}{4}$
4. $\frac{2}{3} + \frac{1}{4} + 4\frac{1}{2}$
5. $2 \times 4\frac{1}{5}$
6. $1\frac{3}{8} \div \frac{3}{10}$
7. $4\frac{1}{5} + 1\frac{1}{4}$
8. $\frac{2}{5} \times 3\frac{2}{3}$
9. $19\frac{3}{5} - 18\frac{4}{5}$
10. $8\frac{5}{12} - 1\frac{5}{6}$
11. $6\frac{4}{5} \times \frac{3}{7}$
12. $8\frac{1}{8} - 1\frac{1}{2}$
13. $1\frac{1}{3} \div 3\frac{1}{3}$
14. $\frac{2}{5} + 1\frac{2}{3}$
15. $25\frac{1}{2} \times 27$

PRACTICE TEST IN DECIMALS II (8 minutes)

1. $.3 + .5 + .8$
2. $.38 - .15$
3. $6 \times .04$
4. $.8 \div .2$
5. $.4 - .375$
6. $.16 + .25 + .37$
7. $3.3 \div .11$
8. 8×3.5
9. $18.63 \div .3$
10. $9.65 + 8.375 + 6.4$
11. $9.3 - 6.25$
12. $1.2 \div 24$
13. $9.637 - 5.0$
14. 48×2.5
15. $91.74 \div .834$
16. $.26 \times 18.4$

PRACTICE TEST IN PER CENT II (8 minutes)

1. .2 = —%
2. $.12\frac{1}{2}$ = —%
3. $\frac{1}{3}$ = —%
4. 8 = —% of 32
5. 7% of 174 =
6. 7 = 20% of —
7. 100% of 60 =
8. 15 = —% of 75
9. 3% of — = 18
10. 8 = —% of 64
11. $37\frac{1}{2}$% of 400 = —
12. 150 = 120% of —
13. 37.5% of 720 =
14. 140 = —% of 70
15. 200% of — = 520
16. 40% of \$3.75 =

CUMULATIVE TEST III

You should be able to work all of these examples in *fifteen minutes.*

1. 947(*3*)
369
526
787
450

3. 9.8(*25*)
25.64
3.596
58.46

5. 78,096(*3*)
−27,998

7. 46.01(*25*)
− 3.5046

2. 859 × 95 (*3*)

4. 764 × 74 (*3*)

6. $68\overline{)28{,}220}$ (*3*)

8. $39\overline{)32{,}933}$ (*3*)

9. $7\frac{1}{4} + 8\frac{5}{6} + 5\frac{7}{8} =$ (*12*)

10. $26\frac{7}{8} - 14\frac{5}{6} =$ (*14*)

11. Multiply $8\frac{3}{4}$ by $8\frac{2}{7}$. (*17*)

12. $16\frac{1}{2} \div 1\frac{2}{9} =$ (*19*)

13. Add 84.6, 2.75, .654 and 8.79. (*25*)

14. 539.1 − 65.004 = (*25*)

15. 9,856.32 ÷ 4.81 = (*27*)

16. 3.05 × .16 = (*26*)

17. $33\frac{1}{3}\%$ of — = \$5.75. (*35*)

18. $4\frac{1}{2}\%$ of \$100 = (*34*)

19. 27 × $4\frac{1}{3}$ (*17*)

20. $\frac{1}{2}$ = —% of 8 (*35*)

21. Express $37\frac{1}{2}\%$ as a fraction. (*31*)

22. If the sale was \$4,000 and the net proceeds were \$3,600, what was the rate of commission? (*39*)

23. If the sale price of a hat was \$6.30 and the reduction was 30% of the regular price, find the price. (*33*)

24. Find the amount of a loan of \$450 for 3 years if the rate of interest is 6%. (*34, 129, and Gd. VII*)

25. Find the volume of a rectangular solid, $2\frac{1}{2}$ feet long, $3\frac{1}{4}$ feet wide, and 8 feet high. (*17 and Gd. VII*)

A TEST OF KNOWLEDGE OF DENOMINATE NUMBERS

One of the numbers in each of the following statements is the correct answer. Write on your paper the numbers from 1 to 26 and write the correct answer for each example.

1. In a foot there are 3, 9, 12, 27 inches.
2. A gallon is 2, 4, 8, 12 quarts.
3. A minute is 30, 60, 90, 75 seconds.
4. A square foot is 144, 200, 27, 12 square inches.
5. In a bushel there are 3, 4, 5, 8 pecks.
6. A pound is 12, 14, 16, 27 ounces.
7. A pint is $\frac{1}{8}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{12}$ gallon.
8. A quart is 2, 4, 8, 5 pints.
9. In a yard there are 12, 24, 36, 48 inches.
10. Freezing temperature is at 10, 20, 32, 42 degrees.
11. In a day there are 12, 18, 24, 36 hours.
12. A rod is equal to $2\frac{1}{2}$, $5\frac{1}{2}$, $15\frac{1}{2}$, $16\frac{1}{2}$ feet.
13. A ton is 2,000, 2,500, 1,000, 4,000 pounds.
14. 18 inches are $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{6}$ yard.
15. A peck is 4, 2, 8, 12 quarts.
16. An acre is 120, 160, 180, 144 square rods.
17. Twelve ounces is $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{8}$ pound.
18. A mile is 3,240, 4,280, 5,280, 5,000 feet.
19. A square yard is 4, 8, 9, 27 square feet.
20. A bushel is 2, 12, 32, 60 quarts.
21. Four cookies are $\frac{1}{3}$, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$ dozen.
22. Fifteen inches are $\frac{1}{2}$ foot, $1\frac{1}{2}$, $1\frac{1}{4}$, $1\frac{1}{6}$ feet.
23. A half bushel is 12, 15, 18, 16 quarts.
24. A mill is equal to $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{10}$ cent.
25. A cubic yard is 12, 18, 27, 36 cubic feet.
26. Oz. is the abbreviation of foot, hundredweight, ounces.

PROBLEM SCALE II

1. A salesman, on a commission of 5%, sold during October goods valued at $3,000. What was his commission for the month?

2. Each $\frac{1}{8}$ of an inch on a map in Lucy's book represents 10 miles. What is the distance represented by a line on the map $1\frac{3}{4}$ inches long?

3. The list price of a piano is $600. The trade discounts are 15% and 10%. What is the net price?

4. An agent sold a 120-acre farm for $180 an acre. What was his commission at $3\frac{1}{2}$%?

5. A hall is $21\frac{3}{4}$ feet long and $10\frac{1}{2}$ feet wide. At 12 cents a foot, how much will it cost to put a moulding around this hall?

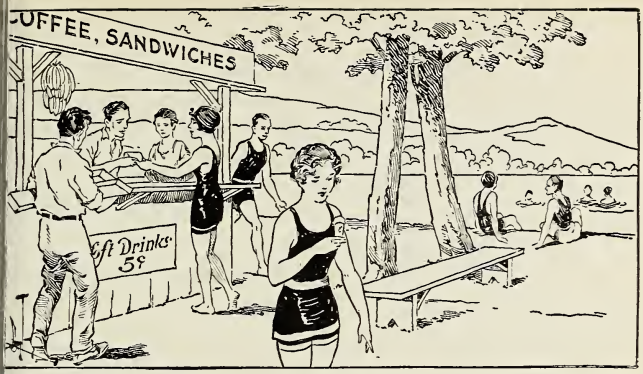
6. Arthur raised strawberries in his garden. He sold 12 boxes at 15¢ a box, 10 boxes at 14¢ a box, and 25 boxes at 18¢ a box. What was the average amount Arthur received a box?

7. An automobile travelled 32.4 miles in 1 hour and 15 minutes. What was the average number of miles an hour travelled?

8. A clerk receives a salary of $950 a year. He spends $275 a year for board, $180 for clothing, and $150 for other expenses. What per cent of his salary is left?

9. What will be the cost of cementing a triangular piece of ground at $1.20 a square yard if the dimensions are base 40 feet and altitude 25 feet?

10. Arthur travelled the 45 miles to the lake in $1\frac{1}{2}$ hours. He rode back in $1\frac{3}{4}$ hours. How many miles an hour on the average did he travel going to and from the lake, making no allowance for any stop-over?



SECTION IV

THE BOYS CLUB GOES INTO BUSINESS

The members of the Lakeville Boys Club decided to run a refreshment stand at the lake summer resort in order to add to their savings for college. Each boy drew out some of the money he had deposited in his school savings account during the past year. This money was to be used to purchase supplies for the refreshment stand. The boys decided to pay interest out of the profits at the rate of 6% a year for the money invested by each of the boys and to divide the balance of the profits equally.

The amount lent by each of the boys was as follows:

William	$48.00	Edward	$62.00
John	30.00	Arthur	44.00
Henry	25.00	Keith	27.50
Dick	45.00	Fred	36.00
George	50.00	Leo	37.50
Carl	24.00	Elmer	21.00

1. What was the total amount lent by the boys?

2. The boys worked hard all summer and did a good business. At the end of four months, when vacation was over, the boys had sold all of their supplies. There was a balance in the treasury of $1,266.16. This was how much more than the total amount the boys had lent? How had the boys planned to divide this money?

3. How much interest did each boy receive for the use of the money he had lent?

Think: 4 months is $\frac{1}{3}$ year.

4. What is the *amount* each boy should be paid out of the earnings of the enterprise? *Amount* here means "principal plus interest."

5. After each boy had been paid the principal and interest of his loan, how much money remained?

6. How much did each boy receive from the money that was left?

7. How much did each boy have after the money had been divided at the end of the season?

8. What per cent of the total loan was contributed by Edward? by Carl? by George?

9. Dick thought that the amount that was left should have been divided among the boys according to the amount each of them had lent. Which method of dividing the money do you think is the better, the method they agreed upon or Dick's method? Why?

***10.** Suppose that the boys had operated the stand at a loss during the summer. Would they have been paid interest on their loans? What would have been a fair way to share the loss? Discuss reasons why the boys might have lost money.

The Dealer's Margin

1. Some goods which cost \$15 were sold for \$18. How much was the dealer's margin? Remember that margin or gross profit is the difference between the cost and selling price. It includes both net profit and overhead charges. The selling price includes the *cost*, *overhead charges*, and the *net profit*.

2. Harry bought an old sailboat for \$115. He spent \$16 for paint and repairs and \$28 for a new sail. What was the total cost of the sailboat? If he sold the boat for \$175, what was his net profit?

3. One summer Harry's eldest brother, Richard, paid \$600 for books which he sold during his vacation for \$1,000. His overhead expenses were \$275. What was his net profit? What per cent of his total sales was his net profit?

Find the net profit and the per cent of net profit for each of the following based on sales:

	Sales	Cost	Overhead
4.	\$6,000	\$4,000	\$1,500
5.	\$7,200	\$5,000	\$1,400
6.	\$8,400	\$6,000	\$1,700
7.	\$9,500	\$7,650	\$1,375
8.	\$60,000	\$48,000	\$8,400
9.	\$77,000	\$56,000	\$13,300
10.	\$25,000	\$18,000	\$2,000
11.	\$64,050	\$50,000	\$8,926

***12.** Find the per cent of net profit in examples **4 to 7** based on the total cost.

***13.** In examples **8** to **11** find the per cent the overhead is of the total sales.

14. A dealer estimates that 20% of his total sales is needed for overhead and 10% for net profit. What per cent of his total sales is needed for overhead and profit? What per cent of his total sales is paid for materials?

15. A dealer pays \$52 for a radio. He estimates that 25% of his total sales is needed for overhead. He wishes to sell the radio so that he can make a profit of 10% of the selling price. At what price should he sell the radio?

Think: Overhead + profit = 25% + 10% = 35% of the sales; hence, the cost of the radio is 100% − 35% or 65% of the sales.
65% of the selling price = \$52.
\$52.00 = 65% of ?

NOTE: In the following problems, profits are to be based upon the sale price.

16. If a dealer allows 6% of his sales for profit and 30% for overhead, at what price should he sell a table for which he paid \$51.20?

17. Allowing 28% for overhead and 12% for profit, what should be the selling price of an article which cost \$36?

18. Allowing 36% for expenses and 10% for profit, what should be the selling price of an article which cost \$64.80?

19. A speed boat was sold for \$750. If the dealer's profit was 12% of the selling price, what was the total of the overhead and cost of the boat?

20. One month a hardware firm had sales amounting to \$56,000. Overhead was 28%, net profit was estimated at 7.5%, and the remainder was used to pay for the cost of the goods sold. Find the amount of money received from sales which was used for each of these purposes.

THE MEANING OF INVOICE

If you purchase groceries for your mother, you usually receive an itemized list of the articles purchased, together with their price.

In the same way, when a wholesale dealer sends goods to a retail dealer he sends him an *invoice* at the time of shipment. The invoice contains a list of the articles, the quantity of each, its price, and the method of shipment.

An invoice usually contains also a statement of the terms of payment.

1. This illustration is an invoice. Who is the shipper?

No. 926 Your Order No. 863 Date Shipped June 1, 19— Via C.N.R. Express

To The Green Grocery Co.,

Address Morris, Man.

INVOICE

THE BLACKBURN & BOARD CO.

WHOLESALE GROCERS

CALGARY VANCOUVER SASKATOON

HOME OFFICE AND FACTORY

BLACKBURN BUILDING, 329 PORTAGE AVENUE, WINNIPEG, MAN.

Terms 2/10, n/30

Quantity	MERCHANDISE	Unit Price		Extension		TOTAL	
2 casks	T. Prunes	78	75	157	50		
10 bags	P. Tapioca	7	12½	71	25		
5 bags	S. Pepper	18	00	90	00		
5 bbl.	P. R. Molasses	16	66⅔	83	33	402	08

2. How were the goods shipped?

3. What is the price of each item in the bill? How were the figures under "Extension" found? Check them.

Notice that this invoice reads, "Terms, 2/10; n/30." This stands for "two per cent ten days, net thirty days." If the bill is paid within 10 days after it is received, the purchaser may deduct 2% from the amount of the bill. This deduction is called a *cash discount.*

4. This invoice was paid 15 days after it was received. How much was paid by the Green Grocery Company?

5. How much would the Green Grocery Company have saved if the invoice had been paid in 10 days?

Practice in Making Out Bills

Rule bill heads and make invoices for the following purchases, assuming that you are the purchaser:

1. Bill of The Certain Seed Co., Morris, Man., March 1.
   Terms: Cash.
   12 assorted seed pkg ..... @ .10¢
   2 lb. onion sets ..... @ .20¢
   ½ doz. bulbs ..... @ 1.20

2. Bill of The Athletic Goods Co., Calgary, Alta., May 3.
   Terms: 30 days
   1 catcher's mitt ..... @ $6.00
   2 league balls ..... @ $1.75
   2 bats ..... @ $2.00

3. Bill of the store where you buy dry goods, June 5.
   Terms: On account
   3 yd. tablecloth linen ..... @ $2.00
   6 pr. stockings ..... @ $1.50
   1 doz. handkerchiefs ..... @ $3.00
   2 doz. handkerchiefs ..... @ $1.50

TRADE DISCOUNT

When Mr. Ajax, a retail merchant, orders goods from his wholesale house, he refers to the wholesaler's catalogue in which *list prices* are given. To find how much the goods will cost him he refers to a discount sheet on which are given the discounts allowed from the list prices. Such a discount is called *trade discount*. The *net price*, paid by Mr. Ajax, is the list price less the discount.

1. Mr. Ajax ordered automobile supplies listed at \$500. The trade discount was 20%. What was the net price of the supplies?

2. Mr. Ajax bought an automobile listed at \$1,000. The trade discount was 25%. What was the net price?

3. Mr. Ajax bought some tires listed at \$1,080. The trade discount was 25%. He was also allowed a 2% discount for cash. What was the net cost of the tires?

Think: First trade discount is 25% of \$1,080, or \$270.
First net price = \$1,080 − \$270 = \$810.
Second trade discount is 2% of \$810, or \$16.20.
Second net price = \$810 − \$16.20 = \$793.80.

Two discounts such as these are called *successive* or *chain* discounts. They may be written as 25% and 2%. The second discount is taken from the amount left after the first discount is deducted. Sometimes there are as many as three successive discounts.

Find the net prices from the following:

4. \$800 less 25%
5. \$650 less 5%
6. \$480 less $12\frac{1}{2}$%
7. \$650 less 10%
8. \$756 less 20%, and 5%
9. \$847 less 30%, and 10%
10. \$750 less 25%, and 5%
11. \$800 less 20%, and 6%
12. \$900 less 15%, 10%, and 5%
13. \$840 less 25%, 15%, and 4%

14. \$628 less 15%, 10%, and 5%

15. \$529 less 30%, 20%, and 2%

Another way to find net prices is as follows:

16. Find the net price of a bill of goods listed at \$400, if the trade discount is 20%.

	Solution I	*Solution II*
Since the trade discount is	\$400	\$400
20%, the net price is 100% −	.80	.20
20%, or 80% of the list price.	\$320.00	\$80.00
80% of \$400 = \$320.		\$400 − \$80 = \$320

Which method do you prefer, Solution *I* or Solution *II*?

17. Use the methods explained in problem **16** to find the net prices in examples **4** to **7.** Check by comparing answers found by each method.

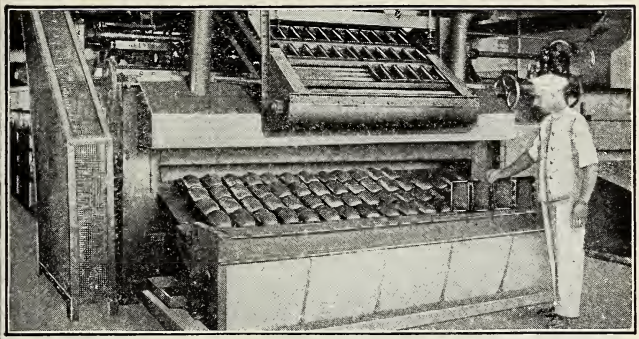
18. Find the net price of a bill of goods listed at \$700, if the trade discounts are 25% and 10%.

If we deduct 25% from the list price, the net price is 75% of the list price.	\$700	\$525
The second discount is 10% of \$525.	.75	.90
Therefore the final net price is 90% of \$525, or \$472.50.	\$525	\$472.50

19. Find the net prices in examples **8** to **15**, using this method. Compare the answers found by each method.

20. If the discounts in problem **18** were 10% and 25%, what would the net price be? Compare your answer with the answer of problem **18.** Does the order of discount affect the net price?

21. Check your answer to the question in problem **20** by finding if the net prices in examples **10** to **15** are the same when the order in which discounts are found is different.



THE COST OF BAKERS' BREAD

In preparing a batch of bread dough, a large bakery mixed materials as shown in the table:

Materials	Weight Pounds	Price a Pound	Cost
Flour (1 barrel)	196	$2\frac{1}{2}$¢	?
Water	102	..	..
Salt	$3\frac{2}{5}$	$2\frac{1}{2}$¢	?
Sugar	$7\frac{4}{5}$	$6\frac{1}{4}$¢	?
Milk powder	$7\frac{4}{5}$	12¢	?
Lard	$5\frac{9}{10}$	15¢	?
Yeast	2	75¢	?
Total	?		?

1. What was the total weight of the mixture?

2. In baking, the weight was reduced to 276 pounds. How many pounds did the mixture lose in baking?

3. Find the cost of all the materials together. Find the cost of a pound loaf to the nearest cent.

4. The bakery added 4 cents a loaf to the cost of materials for labour, delivery, fuel, and other expenses. How much more or less was this than the cost of materials?

5. The grocer sold bread for 11 cents a pound loaf. How much profit did he make on each loaf sold?

INSURANCE

Without a moment's notice our property may be destroyed by fire or other causes. Because of this, owners of property of all kinds protect themselves against the entire loss through *insurance*. In what ways may property be destroyed?

To protect their families, most men carry life insurance, a written agreement by an insurance company to pay losses or damages arising from specified causes listed in the agreement.

Discuss with your parents the advantages of insurance. Find about the insurance they carry. Ask them to tell of cases in which insurance has been a great help to people with whom they are acquainted.

Kinds of insurance. In the Jones family budget there was an allowance of the following amounts for different kinds of insurance:

Fire insurance on home and garage	$56.00
Automobile insurance	36.75
Accident insurance	8.35
Life insurance carried by Mr. Jones	125.65
Total	?

1. What was the total amount of money (*premiums*) to be paid for insurance?

2. Why do people carry fire insurance? In what parts of our country do many people carry tornado insurance?

An agreement by an insurance company to pay a certain amount of money is called a *policy*. The amount specified in the policy is called the *face of the policy*. The length of time the insurance is in force is called the *term*. Insurance *lapses* when premiums are not paid at the proper times.

3. In February Mr. Jones paid the fire insurance premium to the company. In April of the same year his house was damaged by fire. The cost of repairs was $1,250, which was paid by the insurance company. How many times the amount of the premium paid by Mr. Jones was this amount? If Mr. Jones were the only one who paid premiums, the company could not do business. Because so many other people carry insurance the cost for each one is much reduced.

4. Mr. Jones carried $5,000 of life insurance. If his total premium was $125.65, how much was his premium on each thousand?

5. Mr. Jones sent a box of books valued at $500 by express to a neighbouring city. He had the books insured for $300. How much would he receive for the books if they were lost by the express company and never delivered?

***6.** There are various kinds of automobile insurance, such as fire and theft, liability, collision. Find out what you can about each. What premium rates are charged for the various kinds of insurance?

Fire hazards. A fire insurance company studies the conditions under which damage to property by fire takes place and adjusts its premiums on a piece of property according to the possibility or risk of its being damaged.

A piece of property in a neighbourhood where there are many fire hazards is a dangerous risk, and the premiums are higher than they are in a district with few fire hazards and good fire protection.

The premium rates for fire insurance depend upon:

a. The location of the building
b. The use made of the building
c. The construction of the building
d. The use and construction of the neighbouring buildings

*1. Rank these locations in the order of their fire hazard. Where do you think the risk of loss through fire might be greatest because of the location? Give the reasons for your rankings. On which should insurance rates be highest?

a. A house in the country
b. A house in the residence section of the city
c. A house next to an oil reservoir
d. A house in the outskirts of the city, two blocks from a fire hydrant

*2. Rank these buildings in the order of their fire hazard because of the use made of the building. Justify your rankings. On which should insurance rates be highest?

a. A residence
b. A public garage
c. A paper-box factory
d. A furniture factory

*3. Rank these buildings in the order of their fire hazard because of their construction. Give the reasons for your rankings. On which should insurance rates be highest?

a. A new frame house
b. A fireproof schoolhouse
c. A store building partly of brick and partly of wood
d. An old frame house with defective electric wiring

GROWTH OF FIRE INSURANCE IN CANADA

The amount of fire insurance in force in Canada has increased very rapidly. The table below gives data for a period of ten year intervals.

Year	Amount in Force at End of Year	Net Premiums Paid	Losses Paid	Average Cost a $100 of Insurance
1880	$412,600,000	$3,500,000	$1,700,000	$1.00
1890	720,700,000	5,800,000	3,300,000	1.13
1900	992,300,000	8,300,000	7,800,000	1.25
1910	2,034,300,000	18,700,000	10,300,000	1.36
1920	5,969,900,000	50,500,000	21,900,000	1.05
1930	9,673,000,000	52,600,000	30,400,000	.80

1. The amounts, premiums, and losses paid are expressed to the nearest hundred thousand dollars. Give the data for each year, correct to the nearest million dollars.

2. Find the average yearly increase in insurance between 1880 and 1890; between 1920 and 1930.

3. About how many times as much fire insurance as in 1880 was in force in 1890? 1900? 1910? 1920? 1930?

4. How much more than the losses were the net premiums in 1880? in 1890? Were the net premiums in any year less than the losses paid? If the losses over a period of time are greater than the net premiums, what is likely to happen to the premium rates?

5. What per cent of the net premiums were the losses in 1880? in 1890? in each of the other years? Carry your work in each case to the nearest tenth of a per cent.

6. During what years did the average cost of insurance increase, according to the table? during what years did

it decrease? How might the increase in the amount of insurance lead to a reduction of rates?

*7. Make a bar graph of the data presented in one of the columns of the table.

*8. Make bar graphs showing the facts given in the table below, which shows the increase in life insurance over a period of years for Canada.

	Total in Force	Average per Person
1870	$43 millions	$11.78
1880	91 millions	21.45
1890	248 millions	51.98
1900	431 millions	81.32
1910	856 millions	122.51
1920	2,657 millions	310.55
1930	6,492 millions	636.00

Premiums on fire insurance. The premium for fire insurance is stated as a certain amount for each $100 of insurance. The length of time covered by a policy is usually 1 year, 3 years, or 5 years. Yearly rates for 3 years are somewhat less on the average than rates for 1 year. In cities and towns of Western Canada, three years' coverage is given for two annual premiums.

Here are the premiums on each $100 in a certain city.

Type of Building	Rate on $100	
	1 Year	3 Years
One-family house:		
Shingle roof	30¢	75¢
Composition roof	26¢	65¢
Two-family house:		
Shingle roof	36¢	90¢
Composition roof	30¢	75¢

1. Why are the rates on a building with a shingle roof higher than the rates on a building with a composition roof?

2. Why are the rates on a two-family house higher than the rates on a one-family dwelling?

3. Find out the rates on similar buildings in your city.

4. Find the premium on a $2,000 insurance policy for a one-family house with a composition roof at the above rates for 1 year; for 3 years.

5. Find the premium on a two-family house with a shingle roof for a policy of $6,000 for 1 year; for 3 years.

6. A merchant insured his stock, valued at $18,000, for 75% of its value, at a premium of $\frac{3}{4}\%$ of the face of the policy. How much was the premium?

7. Find the premiums on each of the following policies:

a. $600 at $\frac{1}{2}\%$ premium
b. $750 at $\frac{3}{5}\%$ premium
c. $4,800 at $1\frac{1}{2}\%$ premium
d. $7,500 at $\frac{3}{4}\%$ premium

Property is not always insured for its full value, since only rarely are buildings entirely destroyed. Usually a building is insured for from 50% to 75% of its value.

8. A house worth $8,500 was to be insured for $6,500 at 25¢ a hundred for 1 year or 70¢ a hundred for 3 years. Find the premiums for each period of time.

9. A man decided to insure his $10,000 house for 75% of its value. The rate for 1 year was 31¢ a hundred, for 3 years 85¢ a hundred. Find the premium he must pay at each of these rates. How much would he save by taking out the same amount of insurance for 3 years?

10. A man insured his $8,000 house for $\frac{3}{4}$ of its value at 28¢ a hundred. A few months later there was a fire which resulted in damage amounting to $3,000. This loss the insurance company paid promptly. How much more did the man receive than he had paid as a premium?

AUTOMOBILE INSURANCE

William Abel's father has bought a new automobile. He is told that because of the frequency of automobile thefts, the great danger of fire, and the risk of damaging other cars, he should take out automobile insurance. He learns that the chief kinds of automobile insurance are:

a. Fire. *b.* Theft.
c. Damage to the property of other persons.
d. Collision—damage to his own automobile.
e. Liability—injury to others.

a. **Fire risks.** The parts of an automobile which cause fire risks are the gas tank, carburetor, exhaust, pipes carrying gasoline, and the electrical system. Premium rates vary according to the general construction of the car, the size and location of the gas tank, the type of electrical equipment, and the age of the car.

b. **Theft.** Modern automobiles are usually well protected against theft by locks which control the ignition and the transmission. The doors of enclosed cars can be locked also, but still many cars are stolen each year. Low-priced cars are stolen more frequently than higher-priced cars and cars are stolen more frequently in cities than in the country. Can you see why the premium rates for theft insurance vary?

c. **Damage to the property of other persons.** A news item stated recently that there are more automobiles than bath tubs in Canada. Would the risk of property damage increase or decrease with an increase in the number of cars? Would the risk be greater or less in the city than in the country? Which would be a

greater risk so far as property damage is concerned—a pleasure car driven two or three times a week or a car driven every day for business purposes? The premium rate on a certain type of car is four times as great in a large city as the rate on the same car in the open country. When an automobile is protected by insurance against damage to the property of others, the insurance company pays the cost of damage, usually up to $1,000, if the insured car runs into another car or damages property.

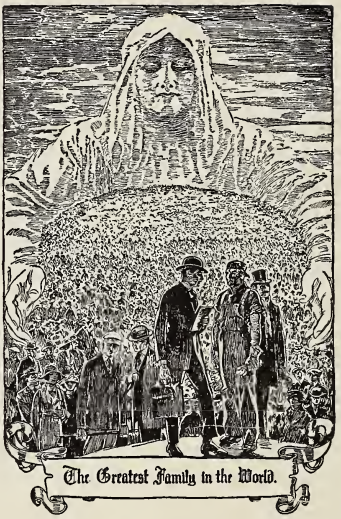
d. **Collisions.** If a person has his car insured against damage to the property of others, the insurance company does not pay him for any damage done to his own car unless he carries "collision" insurance. There are various types of this insurance depending upon the amount of premium paid. One kind of collision insurance provides that any damage up to $35 must be paid by the owner of the car. Damage beyond this amount is paid by the insurance company. It is possible to obtain "collision" insurance policies wherein the insurance company guarantees to pay the entire damage to one's car in case of a collision. The premium rates are higher for this type of insurance than for collision insurance, where the owner of the car must pay for the first $25 or $35 damage.

e. **Liability to others.** If a man driving a car injures another person, he becomes liable (may be sued in court) for the damage or loss of life he has caused. Insurance companies sell a form of automobile insurance policy in which they agree to pay the costs of any injury or death up to a certain amount, usually $10,000. Since actual injury caused by one driving an automobile often costs thousands of dollars, it is wise for the owner of a car to carry this type of insurance.

PERSONAL INSURANCE

Personal insurance is concerned with the insurance of a person against accident, illness, or death.

One of the most common forms of accident insurance is carried by travellers on railroads, steamships, and bus lines so that, in case of loss of life through an accident while travelling, the family or estate may have protection against hardship. Policies covering a single trip may be bought at a very low rate at most railroad ticket offices. Long term policies may be purchased from insurance agencies.

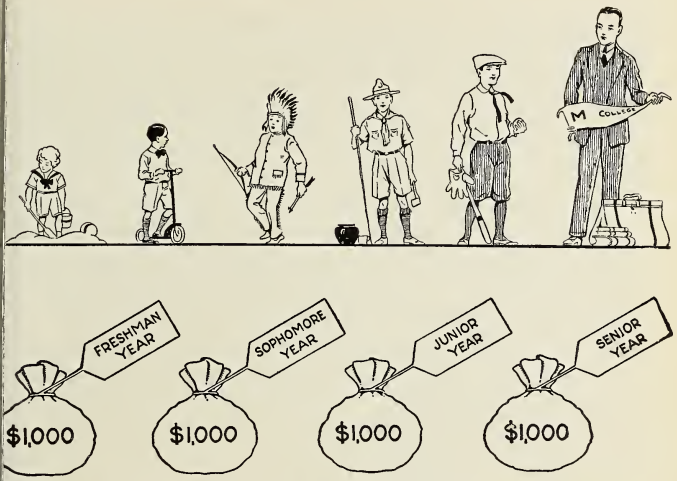


The life-insurance family of Canada numbers more than four millions of people.

The most common form of health insurance guarantees the individual a certain income during illness. The rates vary according to the insured person's occupation, and according to the length of time the income is guaranteed.

There are four kinds of life insurance policies: *ordinary life, limited life, term insurance,* and *endowment.*

Ordinary life policies provide that the insured person shall pay a premium during his lifetime, either annually or semiannually. Premiums on industrial insurance



Educational fund insurance policies may be bought by a parent to provide money for a college education for his boy or girl.

policies are paid weekly or monthly. Upon the death of the insured the insurance company agrees to pay a specified sum to the heirs, or to some other person or persons named in the policy. A party who is to receive insurance money is called a *beneficiary*.

A *limited payment* policy provides that premiums are to be paid during the life of the insured for a specified number of years, usually 10, 20, or 30 years, after which the policy is said to be paid up and no more premiums are paid. The face of the policy is paid the beneficiary upon the death of the insured. If death occurs before the end of the specified number of years, the face of the policy is paid the beneficiary and no further premium need be paid.

In *term* insurance, the premiums are paid for a definite period of time, and the face of the policy is paid to the beneficiary only in case the insured dies during this period. Many companies prefer not to write term insurance and offer it merely as a temporary convenience. Term insurance can be converted into some other form of insurance at the option of the insured.

An *endowment* policy is a form of investment which combines with it the insurance feature. A person pays premiums for a certain number of years specified in the policy, at the end of which time the face of the policy is paid to him. If death occurs before the end of the time during which premiums are payable, the face of the policy is paid the beneficiary. The premiums are much higher than those for the other three kinds of insurance. However, it must be remembered that insurance is not primarily a form of investment. Its chief purpose is protection. Every intelligent person who has dependents buys insurance to protect them.

Here are the descriptions of four life insurance policies that were settled in different ways. Which was an endowment policy? Which was a term policy? an ordinary life? a limited payment policy?

1. Mr. Jones paid premiums of $24.08 for 20 years on a $1,000 policy, at the end of which time his payments were completed and his insurance was paid up. He died three years later and his estate was paid $1,000 by the insurance company.

2. Mr. Smith paid insurance premiums of $12.84 for 10 years on a 10-year policy. He paid no further premiums and his estate received no money from the insurance company when he died eight years later.

3. Mr. Anderson took out a policy for $1,000 when he was 24 years old. He paid premiums of $13.97 each year until his death at the age of 57, when the insurance company paid his beneficiary $1,000.

4. Mr. Jackson took out a 20-year policy for $2,000 at the age of 28. He paid the premiums for the 20 years, at the end of which time the insurance company sent him a check for $2,000.

Premium rates for life insurance. The following table used by a certain life insurance company shows the annual premiums on $1,000 for various kinds of policies taken out at different ages:

Age of Insured	Ordinary Life	20-Year Endowment	20-Year Limited Payment
20	$15.07	$43.06	$28.05
25	16.97	43.30	30.42
30	19.28	43.86	33.27
35	22.29	44.67	36.62
40	26.17	45.89	40.27

1. For which kind of policy are the premiums largest? What do you think are the reasons for this?

2. For what kind are the premiums smallest? Why?

3. How much less are the premiums for insurance taken out at the age of 20 than at the age of 25?

4. Why are the premiums for age 20 less than those for age 25 or 30?

5. What is the yearly premium of a 20-year limited payment policy for $5,000 insurance taken out at the age of 20? 30? 40?

6. What reasons can you give for taking out insurance at an early age?

7. Insurance agents are paid commissions on the premiums for the insurance they sell. What is the amount of the commission on an ordinary life policy taken out at the age of 30 for $5,000 if the rate of commission is 20% of the first premium?

8. What is the sum total of all premiums paid on a 20-year endowment policy for $2,000, taken out at the age of 25?

*9. Are the rates for men and women the same? Can aviators be insured against death or accident? What effect has war on insurance?

10. What will the premiums on an ordinary life policy for $1,000, issued at the age of 25, amount to in 40 years? Is this more or less than the face of the policy?

11. What will the premiums on a 20-year endowment policy for $1,000, issued at the age of 30, amount to in 20 years?

12. If you take out an ordinary life policy at age 20, how much will you have paid in premiums at age 40? at age 60?

13. Would you recommend that a person invest all his savings in bonds and mortgages instead of using part of them for insurance? Why?

14. What are the yearly premiums on the following policies at the rates on page 101?

a. Issued at the age of 20, ordinary life, face $6,000.

b. Issued at the age of 25, 20-year endowment, face $2,000.

c. Issued at the age of 35, 20-year limited payment, face $3,000.

d. Issued at the age of 40, ordinary life, face $6,000.

e. Issued at the age of 35, ordinary life, face $3,500.

15. What must be the average monthly savings to pay each of the premiums for the five policies mentioned in problem **14**?

How a life insurance company uses its premiums. The premiums that are paid by the insured each year are divided into three parts. One part is used to pay the death claims of that year; another is used to pay operating expenses, such as salaries, commissions of agents, medical examinations, rent, and other items; and the third portion is added to the *reserve fund*—a fund required by law, which assures the payment of every claim as it falls due. The insured may receive, on request, a part of this fund at any time by surrendering the policy, thereby ending the contract with the company. The amount he receives is called the *cash surrender value.* An insured person can also borrow from the insurance company an amount not exceeding the cash surrender value.

The following table used by a certain life insurance company shows various cash surrender values of an ordinary life policy for $1,000, issued at the age of 20:

Age of Policy	Cash Value	Age of Policy	Cash Value
2 year	$ 4.40	8 year	$ 63.34
3 year	21.94	9 year	72.41
4 year	29.71	10 year	81.71
5 year	37.73	11 year	91.40
6 year	46.01	12 year	101.33
7 year	54.54		

1. Mr. Jones took out a $2,000 policy at the age of 20. After 5 years he wished to drop it. What was the cash value for each $1,000? for the whole policy?

2. If he had carried the policy for 12 years, how much would he then have received? Some people think that money paid as premiums is a total loss. Is this correct?

3. Insurance companies will lend the insured person an amount equal to the cash value of the policy. How much can a man 27 years old borrow if he took out an ordinary life policy of $2,500 at the age of 20?

4. The yearly premium on an ordinary insurance policy of $1,000, taken out at the age of 20, is $15.07. If the cash surrender value at the end of the third year is $21.94 for each $1,000, what per cent is this of the premiums that have been paid? Note that four premiums have been paid.

5. If the man mentioned in problem **4** had invested the premium of $15.07 at 5%, compounded annually, what amount would the four premium payments equal at the end of the third year, including the interest on the first three payments?

How much must be saved a month to pay the yearly premium on a $4,000 life insurance policy if the premium is $12.96 a thousand?

CLASS REPORTS

Select one of the following kinds of insurance for a special report to the class:

automobile insurance
marine insurance
old-age insurance
employers' liability insurance
disability clauses in insurance policies
property damage and personal liability insurance carried by autoists
tornado insurance
hail and rain insurance
pensions, which often are a form of insurance

WHY WE PAY TAXES

Who owns the fire department in your town or city? Who pays the salaries of the firemen? Who owns the public-school buildings and pays the salaries of the teachers? Who keeps the streets in good condition? Who pays for the health department? for the police department? Name some property that belongs to all of the people of your community.

In early pioneer days there were no schools, no police department, no health department, no public parks, no libraries. At the present time we have all of these services and many more because people have voted to have them and to raise the necessary money by *taxation*. A great deal of money is needed for these purposes. The officers of our government decide the amount of money that is needed and then notify each property owner what his share of the expenses of government for the year is.

The amount of money each property owner pays is called his *tax*. The amount of tax he pays depends on the value of his property. The owners of a factory or store valued at $25,000 are better able to pay a large tax than the owner of a small home valued at $5,000, and should do so because they need more protection from the police, fire, and other departments than the owner of a small home needs. Every citizen pays his fair share of the expenses of the government.

PROPERTY TAXES

Municipal governments secure a large part of the money needed to pay the expenses of government by a tax on real estate and on personal property.

Real estate consists of land and property attached to the land, such as houses, barns, and garages.

Personal property consists of movable property such as furniture, automobiles, stocks, bonds, and horses.

An official, called an *assessor*, visits each property owner and determines the value of the property he owns. This value is called the *assessed valuation.*

The official whose duty it is to collect the taxes is called the *tax collector.*

The assessed valuation of the property to be taxed in the school district in which Helen Brown lives is:

Name	Real Estate, Assessed Valuation	Personal Property, Assessed Valuation	Total Assessed Valuation
Mr. Brown	$12,000	$1,600	$13,600
Mr. Jurgens	16,500	1,800	?
Mr. Murdock	12,100	2,600	?
Mr. Jones	18,500	2,200	?
Mr. Severson	9,000	900	?
Mr. Clancy	4,800	500	?
Mr. Moore	28,500	4,000	?
Mr. Williams	14,600	1,600	?
Mr. Jenks	19,500	1,700	?
Mr. Ableman	3,600	600	?
Mr. Winters	33,300	4,400	?
Mr. Sommers	21,100	2,100	?
Totals	?	?	?

1. What is the total assessed valuation of real estate and personal property?

2. Which of the persons listed on page 106, must pay the largest tax? the smallest tax?

To find the amount of taxes each property owner must pay, it is necessary to find the rate of taxation.

To find the rate of taxation, *divide the amount of taxes to be raised by the total assessed valuation.* Suppose that the school district in which Helen Brown lives must raise $1,740 for school purposes. What is the rate of taxation?

Think: $1,740 = ? % of $217,500.

$1,740 ÷ $217,500 = .008 or .8%.

The rate of taxation is .8%.

$$\begin{array}{r} .008 \\ \$217{,}500\overline{)\$1{,}740.000} \\ \underline{1{,}740.000} \end{array}$$

3. Find the tax to be paid by each person owning property in the school district. Add these taxes. Does the sum equal the amount necessary for school expenses?

4. If a tax of $2,100 is to be raised on property assessed at $350,000, what will be the tax rate?

5. Does a person owning no property and renting a home pay taxes? Explain.

6. If a grocer includes his taxes in his overhead, who really pays them?

7. Mr. Severson, one of the men listed in the table on page 106, has five children in school. What is the average amount of school taxes he pays for each child?

8. Mr. Jones has no children of school age. Should he pay taxes for the support of the school?

***9.** Do you think that an assessor can reliably determine the value of real estate or personal property that he assesses? Find what may be done by a taxpayer who feels that his property has not been properly assessed.

***10.** Some people think that taxes should be paid only on land values, not on buildings and personal property. What arguments can you offer for this single tax?

WAYS OF EXPRESSING THE RATE OF TAXATION

Property taxes are computed in different ways in various parts of the country. The four chief ways of expressing the rate of taxation are:

a. As so many cents on a dollar; $2\frac{1}{2}¢$ or 2.5¢, or \$.025 on a dollar.

b. As a certain per cent of the assessed valuation; $2\frac{1}{2}\%$ of \$2,000.

c. As so many mills on a dollar; the rate of one mill is .1¢ on the dollar; hence, 2.5¢ is 25 mills on the dollar. A tax of 25 mills on a dollar is the same as a tax of 2.5¢ or \$.025 on a dollar.

d. As so many cents on \$100 or on \$1,000; a rate of 2.5¢ on a dollar is the same as a rate of \$2.50 on \$100 or \$25 on \$1,000.

Thus a tax rate of $2\frac{1}{2}¢$ (\$.025) on a dollar, may be calculated as $2\frac{1}{2}¢$, or 25 mills on a dollar, as \$2.50 on \$100, or as \$25 on \$1,000.

1. Find the taxes on a house having an assessed valuation of \$2,000 if the rate of taxation is $2\frac{1}{2}¢$ on a dollar.

Think: \$2,000 × \$.025 = ?

2. How much is the tax on a store having an assessed valuation of \$5,000 if the rate of taxation is $3\frac{1}{2}\%$?

Think: $3\frac{1}{2}\%$ of \$5,000 = ?

3. A tax rate of 21 mills on a dollar is equal to how many cents on a dollar?

4. Express a tax rate of 7 mills on a dollar as cents on a dollar.

5. How many cents on a dollar is a tax rate of 1.2 mills? 12.5 mills? $3\frac{3}{4}\%$? 5 mills? .4 mills?

6. Find the tax on a garage having an assessed valuation of $350 if the rate is 12 mills on a dollar.

Think: $.012 \times \$350 = ?$

7. If the rate of taxation is $2.35 a hundred dollars, find the tax on a farm assessed at $6,000.

Think: $6,000 is equal to 60 hundreds.
$60 \times \$2.35 = ?$, the tax on the farm.

8. The rate of taxation at Benton Harbour is $31.20 on a thousand dollars. Find the taxes on a factory assessed at $15,000.

9. Which is greatest: a tax of $2\frac{3}{4}\%$, 28 mills, $2.60 a hundred dollars, or $25.89 a thousand dollars? Arrange these tax rates in a table in order of size.

10. Complete the following table:

Cents on $1.00	Per Cent	Mills on a Dollar	Dollars on a Hundred	Dollars on a Thousand
a. $4\frac{1}{2}$				
b.	3			
c.		3.75		
d.			$3.60	
e.				$45.75

Find the tax on each of the following pieces of property:

Assessed Valuation	Tax Rate
11. $3,000	$5\frac{1}{4}¢$ on a dollar
12. $4,800	$3\frac{3}{4}\%$
13. $1,600	32 mills on a dollar
14. $3,750	$3.60 a hundred dollars
15. $12,500	$37.40 a thousand dollars

16. Mr. Jordan's farm is assessed at \$14,600, 15 head of cattle at \$30 each, and 4 horses at \$75 each. What is his total tax if the rate is 34 mills on a dollar?

17. The assessed valuation of a certain city was \$5,320,000. The amount of taxes to be raised was \$127,680. Express the tax rate as cents on a dollar; as a per cent; as mills on a dollar; as dollars on \$100.

18. The tax rate in a city was reduced from \$26.50 a thousand to \$25.98 a thousand. How much was the reduction in taxes on a house assessed at \$5,000?

***19.** If the tax rate is lowered, does the owner of a house necessarily pay less taxes? Explain.

***20.** Find the tax on an 80-foot lot assessed at \$54 a front foot if the rate of taxation is \$4.50 a hundred dollars.

In Grade VII you solved problems by the use of a formula. The following formula is often used to find the rate in mills on the dollar. See if you can understand it:

$$\text{Rate in mills} = \frac{\text{Expenses}}{\text{Assessment}} \times 1{,}000, \text{ or } R = \frac{E}{A} \times 1{,}000.$$

Example: The assessed valuation of a town is \$1,000,000. The town must raise \$50,000 for all purposes. What is the rate of taxation in mills on the dollar?

Solution: $R = \frac{E}{A} \times 1{,}000 = \frac{50{,}000}{1{,}000{,}000} \times 1{,}000 = 50$ mills.

***Taxes in Bland.** The statement on the right was obtained from a tax commission. It gives the amount of county, city, and school taxes for the city of Bland.

Assessed Valuation..	\$5,260,000
	Taxes
County taxes.....	\$34,947.17
City taxes.....	65,351.55
School taxes.....	94,830.67
Total.....	?

1. Find the total taxes to be raised by the city of Bland.

2. What per cent of the total taxes is for the schools? What per cent is spent for other purposes?

3. To find the rate of taxation, divide the amount of taxes to be raised by the assessed valuation of the city. Find the total tax rate for Bland in cents on a dollar. Carry your answer to the nearest tenth of a cent.

4. Find the tax rate on a hundred dollars for county taxes; for city purposes; for school purposes. Carry per cents to the nearest tenth of a per cent.

5. This is a partial list of the property owners in the city of Bland, with the assessed valuation of their taxable property. Make a neat copy of the following table and fill in the blank spaces.

Property Owner	Assessed Valuation		School Tax	County Tax	City Tax	Total Tax
	Real Estate	Personal Property				
Mr. A.....	$6,500	$500	?	?	?	?
Mr. B.....	3,200	200				
Mr. C.....	8,800	900				
Mr. D.....	12,600	3,400				
Mr. E.....	18,500	6,500				
Mr. F.....	7,500	1,000				

6. A school-district budget for a certain year was $6,240. The assessed valuation of the district was $520,000. What was the rate of taxation for school purposes in dollars on a thousand?

*__7.__ Secure a tax receipt from your father or some other person. Check it to see if it is correct.

8. In a small city the assessed valuation of the real estate was $4,550,600; the assessed valuation of personal property was $1,750,000. The tax levy was $126,012. What was the rate of taxation in dollars on $1,000?

*9. Secure a statement of the expenditures and revenues of your own city or town. Find your local rate of taxation. Express it in four ways.

*10. Mr. Ward pays a tax of $225, the rate of taxation being $.025 on a dollar. What is the assessed valuation of his property?

*11. A certain city raised a tax of $558,000 with a tax rate of $.030 on a dollar. What is the assessed valuation of the real and personal property in the city?

An Important Point to Remember

In a newspaper Helen read that the rate of taxation in her cousin's neighbouring town was 45 mills on a dollar. In B where she lived, a town similar to the one mentioned in the paper, the rate was 67 mills on a dollar. She wondered why there was this difference in the tax rates. Her father explained to her that one reason might be the basis used to determine the assessed valuation of property. In town B the property was assessed at 60% of its true or sale value. In town A the property might be assessed at 80% of its true or sale value.

1. Suppose that you own a house and lot in town A. The sale value of the house and lot is $7,000. What is its assessed valuation? What is the assessed valuation of a house with the same sale value in town B?

2. How much are the taxes on such a house in town A? in town B? What is the difference in taxes? You see that the difference in taxes is not so great as it would seem to be from the differences in the rates of taxation. You see also that a town having a low rate and a high valuation might be taxing its citizens more than a town having a high rate and a low valuation.

CUSTOMS AND DUTIES

The Federal Government raises large sums of money by taxes levied on commodities brought into the country. These are called import *duties.* Some countries levy export duties on certain things they export. Most countries levy *excise* taxes or duties on some articles produced or manufactured in the country.

Import and export duties are payable at a *Customs House;* excise duties are payable at an *Inland Revenue Office.*

For the purpose of duty, goods or commodities may be divided into four classes:

(1) Those that are admitted free, that is, without duty of any kind.

(2) Those that are subject to an *ad valorem* duty, that is, a tax of a certain per cent of their invoiced value.

(3) Those subject to a *specific* duty, that is, a certain amount a pound, a yard, a piece, etc., without reference to the value.

(4) Those subject to both an ad valorem and a specific duty.

1. Find the ad valorem duty on a rug valued at $50, if the duty is 20% of its invoiced value.

2. Find the specific duty on a ton of sugar, if the duty is 40 cents a 100 pounds.

3. Find the total duty on 100 pounds of wool yarn, valued at $1.80 a pound, if the specific duty is 20 cents a pound, and the ad valorem duty is 20%.

4. Find the total excise duty on 1,575 pounds of tobacco, if the tax is 25 cents a pound.

THE MEANING OF TARIFF

A list of goods with their duties is called a *tariff*.

At present goods manufactured in most parts of the British Empire have smaller duties when imported into Canada than those paid by most other countries. Some countries because of special treaties also pay duties, called *intermediate*, smaller than those included in the *general* tariff.

The table below shows the Canadian tariff rates on certain commodities in effect January 1, 1936. Since these rates change from time to time, the rates today may not be the same as those given below.

On January 1, 1936 a new Canada-United States trade pact came into force. The United States now, with 23 other countries, enjoys Canada's most favoured nation treatment. Where the general tariff has heretofore applied, the intermediate will now apply. Between the general and intermediate tariffs the ratio varies, but the average is approximately 5 per cent.

	British Preferential	Intermediate	General
Automobiles	Free	17½%	27½%
Apples	Free	15%	20%
Carpets (Turkish)	5¢ a sq. ft. and 30%	15¢ a sq. ft. and 35%	20¢ a sq. ft. and 40%
Leather gloves	25%	25%	45%
Mowers	Free	15%	25%
Petroleum (crude)	⅓¢ a gal.	½¢ a gal.	1¢ a gal.
Starch	1¢ a lb.	2¢ a lb.	2¢ a lb.
Sugar	$.83 a cwt.	$1.00 a cwt.	$1.50 a cwt.
Wool yarn	11¼¢ a lb. and 15%	20¢ a lb. and 20%	22½¢ a lb. and 22½%

1. Name the three tariffs given in the table on page 114.

2. Which articles are without duty in one or more of the tariffs?

3. On which items is there only an ad valorem duty?

4. On which items is there only a specific duty?

5. On which items are there both specific and ad valorem duties?

Using the rates given in the table on page 114 find the intermediate duty on the following:

6. An automobile invoiced at $1,000.

7. 250 bbl. of apples, invoiced at $3.00 a bbl.

8. 4 doz. leather gloves, invoiced at $10 a doz.

9. 15,000 gal. of crude petroleum.

10. 6,000 lb. of sugar.

11. A $200 Turkish rug, 10 ft. by 12 ft.

12. 200 lb. of wool yarn, invoiced at $1.50 a lb.

13. Find the general duty on a shipment of 50 mowers, invoiced at $7.20 each. Find also the total cost of the mowers to the importer.

14. How much less than the general duty is the British preferential duty on a shipment of 1,800 pounds of starch?

15. How much less than the intermediate duty is the British preferential duty on a $750 automobile?

16. How much will be saved by importing from England an 8′ x 10′ Turkish rug, invoiced at $75, instead of from some country which pays intermediate tariff rates?

17. A dealer imported leather gloves from England, invoiced at $120. He paid the duty, and then sold all of the gloves for $200. What per cent of the selling price was the gain?

*18. An automobile invoiced at $1,440 is imported by a Canadian dealer. He pays the following duties:

(1) a general tariff duty of 35% of 105% of the invoice price; (2) a customs war-revenue duty of $7\frac{1}{2}\%$ of 105% of the invoice price; and (3) a special war excise tax of 10% on $142\frac{1}{2}\%$ of the invoice price.

(*a*) Find the total duty.

(*b*) At what price must the dealer sell the automobile so that the selling price will be 20% more than the invoice price plus the total duty.

*19. A grocer imports 80 boxes of raisins, each box containing 25 pounds. The raisins are invoiced at 8 cents a pound. The grocer pays a specific duty of $\frac{3}{4}$ cent a pound, $12 for freight, and $4.00 for warehouse charges. If he retails the raisins at 2 pounds for $.25, how much does he gain?

*20. Look up the meaning of "protective tariff"; "tariff for revenue only"; "free trade." Discuss the arguments for and against each system.

*21. What is the "sales" tax?

*22. What are the present rates of the gasoline tax in your community?

*23. What is the "income tax"?

*24. What are present rates of excise taxes on cigars and liquors?

25. Where are customs officers stationed?

*26. Visit your drug store to find whether any articles sold there have upon them a government revenue stamp. The purchaser of a stamped article is paying a government tax.

Date		Particulars	Initials	Withdrawals		Deposits		Balance	
Jan.	1		M.			$10	00	$10	00
Jan.	15		M.			5	25	15	25
Feb.	1		S.			4	75	20	00
Apr.	8		M.			6	00	26	00
Apr.	30	Interest	S.				13	26	13
May	1		S.	$7	50				?
July	2		K.			4	60		?
Sept.	2		K.			26	00		?
Oct.	1		S.	8	05				?
Oct.	31	Interest	S.				?		?
Dec.	1		M.			5	00		?

WHERE TO PUT YOUR SAVINGS

Savings banks. This is a copy of a page from William Jones' savings-bank book, showing deposits during the year, interest, money withdrawn, and his balance.

The bank in which William deposited his money paid interest on savings at the rate of 2% a year. Interest was computed on April 30 and October 31 each year on the minimum balance each month. The first interest period for William's account was from January 1 to April 30, 1935. The following procedure will help you to find the approximate interest on his savings at 2%:

a. Make a check mark (√) opposite each minimum balance on the passbook.

b. Multiply number of whole dollars in the minimum balance by $\frac{1}{6}$ and express the answer in cents.

c. Do this for each of the four months and add.

NOTE: Two cents is the interest on $1.00 for 12 months. $\frac{1}{6}$ cent is the interest on $1.00 for 1 month.

For a more accurate result, we find from simple interest tables that \$.00165 is the interest on \$1.00 for 1 month.

Find the fraction to be used as multiplier for $2\frac{1}{2}\%$, 3%, $3\frac{1}{2}\%$, 4%, 5%.

1. After interest was credited, April 30, what was the amount of his balance?

2. Find the missing balances up to December 1.

3. On what sums does William draw interest during the second interest period? Interest is paid on dollars only; cents are not considered.

4. Find the amount of interest William will be paid on October 31. What was his balance after interest had been credited on October 31?

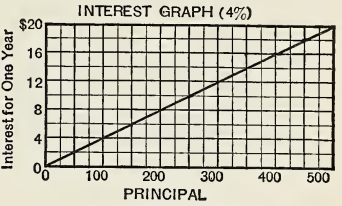
5. What was his balance on December 1?

6. If William makes no further deposits or withdrawals during the five months following December 1, what will his balance be on April 30, 1936?

7. H. R. Masters' savings account showed the following deposits: January 1, 1935, \$140.75; February 5, \$65.60; April 4, \$35; Sept. 3, \$52.50; March 6, 1936, \$57.75. On June 15, 1935, he drew out \$40; January 2, 1936, \$20. If he is allowed interest on the minimum balances for each month at the rate of 2% per annum, on April 30 and October 31, how much interest should Mr. Masters receive to his credit on April 30, 1935? On October 31, 1936? How much is his balance on that date? Tabulate these data in columns headed, Date, Deposits, Interest, Withdrawals, Balance.

8. Some banks pay interest quarterly. If the first period begins on January 1, what are the dates on which interest is due?

*USING A GRAPH TO FIND INTEREST



This graph may be used to find the yearly interest on various amounts of money when the rate of interest is 4%.

1. What does the vertical scale show?

2. Explain the items on the horizontal scale.

3. Use the graph to find the interest on $100 for one year.

4. Use the graph to find the interest for one year on $200; $50; $300; $350; $250.

5. Suppose that the interest on a certain amount of money for one year at 4% is $8.00. Use the graph to find the sum that would yield that interest at 4% a year.

6. Use the graph to find the sum that must be deposited in a savings bank, paying 4%, to yield $4.00 interest a year; $6.00; $10; $12; $16.

***7.** Draw a similar graph showing the amount of interest when the rate is 8% a year.

Using the graph on this page and the graph which you have drawn, find the interest on the following for one year. Then multiply by the number of years, or by the fraction of a year as the example requires, to find the total interest.

	Principal	Interest	Time		Principal	Interest	Time
8.	100	8%	2 yr.	**12.**	500	4%	4 mo.
9.	150	4%	3 yr.	**13.**	450	4%	5 yr.
10.	200	8%	6 mo.	**14.**	400	4%	6 mo.
11.	250	8%	3 mo.	**15.**	350	8%	4 yr.

$ 800 00/100 DUE May 4, 19__
TORONTO, ONT., February 3, 19__
INT. $ 12 00/100
$ 812 00/100 Ninety days AFTER DATE I PROMISE TO PAY
TO THE ORDER OF The Royal Bank of Canada
Eight Hundred and 00/100 DOLLARS
AT THE ROYAL BANK OF CANADA Toronto, Ont. VALUE
RECEIVED WITH INTEREST AT THE RATE OF 6 PER CENT PER ANNUM AS WELL AFTER AS BEFORE MATURITY.
NO. 1
William Brown

PROMISSORY NOTES

Borrowing money from a bank. Mr. Brown borrows $800 from the bank in order to pay cash for his merchandise. He expects to sell the goods at a profit within 90 days, so he borrows this money for that period at 6%. He gives the bank a note for $800. The note is due on May 4, but in Canada Mr. Brown is allowed 3 additional days, called *days of grace*, in which to pay. These extra 3 days make the note legally due on May 7. Interest must be paid on these 3 extra days.

The date in the upper right-hand corner is the date when the note was written. This is called the *date of the note*. The day on which the note is due is called the *date of maturity*. Mr. Brown is the *maker* of the note. The sum of $800 written on the note is called *the face of the note*. The Royal Bank of Canada, to which the money is to be paid, is called the *payee*.

How interest on a note is computed. For how many days did the bank lend the $800 to Mr. Brown?

Think: Feb. 3 to Feb. 28 = 25 days
Feb. 28 to Mar. 31 = 31 days
Mar. 31 to Apr. 30 = 30 days
Apr. 30 to May 7 = 7 days
The bank charged interest for 93 days. 93 days

To find the interest paid by Mr. Brown, use the formula:

$$i = prt$$

What does each letter in the formula represent?

To find the interest on \$800 for 90 days at 6% proceed as follows:

When a loan is made for a certain number of days, the interest is calculated on 365 days, sometimes 366 days, in a year.

$$i = 800 \times \frac{6}{100} \times \frac{93}{365} = \$12.23$$

Find the interest on the following bank loans:

	Principal	Time	Rate		Principal	Time	Rate
1.	\$250	30 da.	6%	11.	\$2,500	27 da.	4%
2.	\$730	30 da.	6%	12.	\$3,250	60 da.	4%
3.	\$675	60 da.	4%	13.	\$1,650	15 da.	6%
4.	\$485	90 da.	5%	14.	\$1,275	83 da.	6%
5.	\$325	60 da.	4%	15.	\$1,845	64 da.	5%
6.	\$180	90 da.	5%	16.	\$2,200	70 da.	5%
7.	\$545	45 da.	6%	17.	\$2,750	40 da.	6%
8.	\$860	75 da.	6%	18.	\$1,956	18 da.	7%
9.	\$935	36 da.	7%	19.	\$3,500	48 da.	4%
10.	\$748	72 da.	5%	20.	\$2,375	88 da.	5%

21. Write a note payable at the Bank of Toronto, using the items mentioned in the first problem.

Who is the maker? What is the face of the note? What is the date of maturity? What amount must the maker pay on the date of maturity?

Vancouver, B. C., March 16, 19 —

On demand — I PROMISE TO PAY TO

C. E. Jackson — $ 400 00/100

Four Hundred and 00/100 — DOLLARS

FOR VALUE RECEIVED WITH INTEREST. L. A. Pearl

IMPORTANT FACTS ABOUT PROMISSORY NOTES

Kinds of promissory notes. This section will teach you some important facts about promissory notes that everyone should know.

There are several kinds of promissory notes. The following notes illustrate some of the various kinds.

This is a *demand note.* Why do you think it is so called?

When the interest is not specified, the legal rate is to be paid. What is the legal rate of interest in your province?

Vancouver, B. C., June 6, 19 —

Four months AFTER DATE I PROMISE TO PAY TO

THE ORDER OF C. E. Jackson $ 150 00/100

One Hundred Fifty and 00/100 — DOLLARS

VALUE RECEIVED. Edward Stephens

In what ways does this note differ from the first one? This is called a *time note.* Why?

Vancouver, B. C., July 7, 19 ——

Ninety days AFTER DATE I PROMISE TO PAY TO

THE ORDER OF C. E. Jackson $ 125 00/100

One Hundred Twenty-five and 00/100 —— DOLLARS

VALUE RECEIVED. INTEREST AT 8 %. Charles Kint

In what respects are these three notes alike? In what respects do they differ?

Who were the makers of the notes on pages 120 and 122?

The party whom the maker promises to pay is called the *payee* of the note. Who were the payees of the notes?

A note in which the maker promises to pay the principal with interest is called an *interest-bearing* note. A note in which the maker promises to pay the principal only is called a *non-interest-bearing* note. Which of the notes are interest-bearing? Which is non-interest-bearing?

Sometimes notes are so written that they can be paid only to the person named in the note, while others are so drawn up that they can be paid to other people and are therefore *negotiable*. A note is negotiable if it is payable to the order of the payee, or to bearer.

1. Which of the notes on pages 120 and 122 are negotiable?

The words "value received" on the notes show that the maker received money or something else of value.

2. Make a list of all the items that should appear on a negotiable, interest-bearing note.

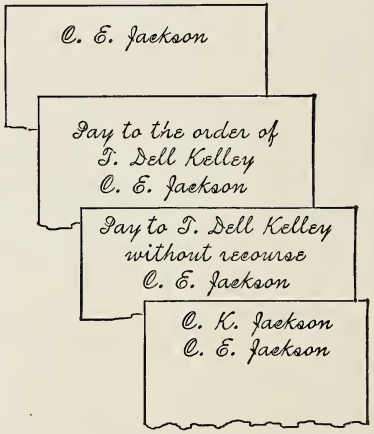
3. Draw up a negotiable, interest-bearing note for $400, payable in 60 days. Be sure to write "specimen" or "sample" across the face of the note so that no one can ever present it for payment.

4. Draw up a non-negotiable note for $300 payable on demand.

5. Why should the face of the note always be expressed in both figures and words?

6. Find from your banker what is done when the maker of a note cannot pay the face of the note when due.

Why and how notes are indorsed. Notes may be sold to other persons if they are negotiable. When is a note said to be negotiable? When is a note said to be non-negotiable?



Suppose the note on page 123 were sold by C. E. Jackson to T. Dell Kelley on September 12. Was this before the date of maturity?

When Mr. Jackson sold the note to Mr. Kelley, it was necessary for him to indorse it.

There are several ways in which notes (and checks also) may be indorsed.

The first indorsement is called an *indorsement in blank.* Mr. Jackson's signature means that he becomes liable

for the payment of the note if the maker fails to pay at maturity. The note is payable to bearer.

The second indorsement is called an *indorsement in full.* When indorsed in this way, the note is payable only to Mr. Kelley, or order. Mr. Jackson is still liable for the payment of the note if the maker fails to pay at maturity.

The third method, which is rarely used, is called *indorsement without recourse.* Using this method, Mr. Jackson assumes no responsibility for the payment of the note if the maker fails to pay at maturity.

1. If you were buying a note, which of these three methods of indorsement should you prefer? If you were selling a note, which of the three methods would you use?

2. Make out a specimen note and transfer it by indorsement to one of your classmates.

3. Ask your classmate to indorse the note so that it will be payable to your teacher only.

How to find the date on which a note matures. On July 15, Harry Jones borrowed $100 from his father to help him complete his farm-club project. His father knew that Harry's corn field was certain to yield a large crop. Harry gave his father a promissory note for 90 days at 6% interest.

How much did Harry pay his father on the date of maturity? On what date was the money legally due? **Remember to add the days of grace.**

To find the date of maturity proceed as follows:

16 da. left in July
31 da. in August
30 da. in September
16 da. in October

93 da., the time of the note.

Count from the date of the note until the number of days stated in the note, plus 3, has been counted.

The legal date of maturity of Harry's note was Oct. 16.

If the note had been for 3 months, the date of maturity would be found by counting forward 3 months from the date of the note and then adding 3 days. Why? The date of maturity would have been October 19.

Find the legal date of maturity of the following:

	Date of Note	Time		Date of Note	Time
1.	Aug. 12, 1930	60 da.	**4.**	Jan. 1, 1931	3 mo.
2.	Oct. 14, 1931	90 da.	**5.**	Jan. 1, 1932	90 da.
3.	Sept. 15, 1930	45 da.	**6.**	Feb. 18, 1931	6 mo.

7. On January 12, 1928, Mr. Smith wished to find how many days remained before the date of maturity of a 60-day note, dated December 15, 1927. How many days were left?

8. On April 1, 1928, Mr. Blank wished to find the number of days to the date of maturity that remained on a 3-month note, dated March 4, 1928. How many days were left?

Finding the time between dates. In the Pine Hollow School the Camp Fire Girls decided to earn the money for their uniforms by canning fruit and vegetables. They had no money saved with which to buy sugar and other supplies needed. They decided to visit the bank to find how their plan could be financed. The banker agreed to lend each girl $25 to be paid on or before March 1, 1931, with interest at the rate of 6%, if their fathers would guarantee payment by also signing the notes.

Each girl signed a promissory note for $25 indorsed by her father, and opened a chequing account at the bank for this amount. Why was it necessary for their fathers to indorse the notes?

Calgary, Alberta, July 16, 19 34

On or before March 1, 1935 I PROMISE TO PAY TO

THE ORDER OF The Central Exchange Bank $ 25 00/100

Twenty-five and 00/100 DOLLARS

VALUE RECEIVED. INTEREST AT 6 %. Mary Green

A. K. Green

The above is a copy of the note that Mary Green signed.

By October 22 Mary had sold enough canned fruit and vegetables so that she was able to repay her loan with interest. To find the length of the interest period, the banker used a table like this one:

From Any Day of	To the Same Day of the Next											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
September	122	153	181	212	242	273	303	334	365	30	61	91
October	92	123	151	182	212	243	273	304	335	365	31	61
November	61	92	120	151	181	212	242	273	304	334	365	30
December	31	62	90	121	151	182	212	243	274	304	335	365

He ran his pencil down the first column until he came to July, the month in which Mary's note was dated. He followed along the July line until he came to the October

column. This showed him that from July 16 to October 16 is 92 days. Since the note was to be paid on October 22, he added 6 days to this, making 98 days as the interest period.

1. How much interest did Mary pay for the use of $25 from July 16 to October 22? If she had waited until the note was due, what would have been the interest period?

2. The remaining girls of the group paid their notes on the following dates:

Jane	Oct. 26, 1934	Carol	Dec. 19, 1934
Susan	Nov. 2, 1934	Bessie	Jan. 2, 1935
Jean	Nov. 6, 1934	Eleanor	Jan. 9, 1935
Rose	Nov. 16, 1934	Myrtle	Jan. 22, 1935
Ada	Dec. 4, 1934	Mildred	Feb. 5, 1935
Marion	Dec. 13, 1934	Hope	Feb. 15, 1935

Find the interest period of each note and the amount of interest paid by each girl.

3. Would the table on page 127 be correct during a leap year in finding interest periods from January to March?

4. Using the table find the number of days from today to:

a. Your birthday
b. July 20
c. The closing day of school
d. Remembrance Day
e. Thanksgiving Day
f. Christmas
g. New Year's Day
h. Halloween
i. Labour Day
j. Dominion Day
k. August 10
l. Empire Day
m. September 9

METHODS OF COMPUTING INTEREST

The cancellation method. In this method time and rate of interest are expressed as fractions. By cancellation of common factors the work is completed.

$$i = \cancel{375}^{15} \times \frac{\cancel{5}}{\cancel{100}_{\cancel{4}\ 2}} \times \frac{\cancel{2}}{\cancel{146}_{\cancel{365}\ \cancel{73}}} = \frac{15}{2} = \$7.50$$

Find the interest on \$375 for 146 days at 5%.

Explain the work above step by step.

Computing interest for more than one year. Find the interest on \$1,250 for $2\frac{1}{2}$ years at 6%.

The interest on \$1.00 for 1 yr. at 6% = \$.06
The interest on \$1.00 for $2\frac{1}{2}$ yr. at 6% = $2\frac{1}{2} \times$ \$.06 or \$.15
The interest on \$1,250 for $2\frac{1}{2}$ yr. at 6% = \$.15 × 1,250 or \$187.50

Practice in computing interest. Choose your own method and solve the following problems:

	Principal	Time	Rate
1.	\$975.00	33 da.	6%
2.	\$1,050.00	108 da.	5%
3.	\$1,365.00	$3\frac{1}{2}$ yr.	4%
4.	\$5,500.00	60 da.	6%
5.	\$8,540.00	1 yr. 4 mo.	6%
6.	\$7,645.00	120 da.	5%
7.	\$1,585.00	2 yr. 9 mo.	6%
8.	\$2,335.00	83 da.	4%
9.	\$785.60	4 yr.	4%
10.	\$1,650.00	63 da.	5%
11.	\$4,375.20	5 yr.	$4\frac{1}{2}$%
12.	\$385.00	45 da.	6%
13.	\$1,700.00	77 da.	7%

14. Ten boys join a pig club. Each agrees to raise a pig and to sell it when it is marketable. The bank lends each boy the amount shown in the table below with which to buy a young pig. Notes are indorsed by the fathers of the boys. Find the interest and amount paid by each boy.

One of the pig-club boys and his pigs.

Name	Face Value	Note Dated	Interest Rate	Note Paid	Interest	Amount
John.....	$8.50	Sept. 1	6%	Jan. 15		
Henry.....	9.40	Sept. 8	6%	Jan. 18		
Robert.....	7.20	Sept. 9	6%	Jan. 21		
William.....	8.00	Sept. 15	6%	Jan. 23		
Charles.....	8.25	Sept. 22	6%	Jan. 28		
Sam.....	9.35	Sept. 28	6%	Jan. 31		
Richard.....	7.60	Oct. 1	6%	Feb. 3		
Edward.....	8.65	Oct. 3	6%	Feb. 6		
Thomas.....	7.75	Oct. 4	6%	Feb. 8		
Philip.....	6.90	Oct. 8	6%	Feb. 15		

15. Mr. Smith buys a house at a cost of $8,000. He pays $3,500 in cash and gives a note for the balance at 6% interest. What are the annual interest charges on the house?

16. On September 1 of each year, during his four years of college, John borrowed $800 from his father at 6%. He

gave a note each year, beginning in 1928, due 5 years after date. On what dates were the notes due? What amount did John pay on the date of maturity of each note, including interest for the five-year interest period for each note?

17. On April 15, Henry borrows $15 from his father with which to buy a used bicycle. He agrees to repay his father on September 1, with interest at the rate of 4%. He earns $1.25 each week by delivering papers. In how many weeks can he earn enough to repay the amount of the loan when it falls due?

How to use an interest table. In finding the interest on a note, banks use interest tables like this one.

SIMPLE INTEREST TABLE—RATE 6%

DAYS	$900	$800	$700	$600	$500	$400	$300	$200	$100
90	$13.315	$11.835	$10.356	$8.876	$7.397	$5.918	$4.438	$2.959	$1.479
60	8.877	7.890	6.904	5.918	4.932	3.945	2.959	1.973	.986
50	7.397	6.575	5.753	4.932	4.110	3.288	2.466	1.644	.822
40	5.918	5.260	4.603	3.945	3.288	2.630	1.973	1.315	.658
30	4.439	3.945	3.452	2.959	2.465	1.973	1.479	.986	.493
20	2.959	2.630	2.301	1.973	1.644	1.315	.986	.658	.329
10	1.479	1.315	1.151	.986	.822	.658	.493	.329	.164
9	1.332	1.184	1.036	.888	.740	.592	.444	.296	.148
8	1.184	1.052	.921	.789	.658	.526	.395	.263	.132
7	1.036	.921	.805	.690	.575	.460	.345	.230	.115
6	.888	.789	.690	.592	.493	.395	.296	.197	.099
5	.740	.658	.575	.493	.411	.329	.247	.164	.082
4	.592	.526	.460	.395	.329	.263	.197	.132	.066
3	.444	.395	.345	.296	.247	.197	.148	.099	.049
2	.296	.263	.230	.197	.164	.132	.099	.066	.033
1	.148	.132	.115	.099	.082	.066	.049	.033	.016

1. To find the interest on $250 for 30 days at 6%, run your pencil down the $200 column until you come to the line which shows the interest for 30 days. The

interest as shown is \$.986. In the \$100 column you find the interest on \$100 for 30 days at 6%, or \$.493. The interest on \$50 is $\frac{1}{2}$ of \$.493 or \$.247. Therefore the interest on \$250 is \$.986 plus \$.247 or \$1.23.

2. Find the interest on \$750 at 6% for 63 days.

The interest on \$700 for 60 da. = \$6.904
The interest on \$ 50 for 60 da. = $\frac{1}{2}$ of \$.986 or \$.493
The interest on \$700 for 3 da. = \$.345
The interest on \$ 50 for 3 da. = $\frac{1}{2}$ of \$.049 or \$.025
The interest on \$750 for 63 da. = \$6.904 + \$.493 + \$.345 + \$.025 = \$7.767 or \$7.77.

3. Find the interest on \$750 at 6% for 75 days.

Practice in using the interest table. Using the interest table, rate 6%, find the interest for each of the following:

	Principal	Time		Principal	Time
1.	\$300	30 da.	**11.**	\$765	72 da.
2.	\$600	90 da.	**12.**	\$943	54 da.
3.	\$400	60 da.	**13.**	\$837	34 da.
4.	\$500	45 da.	**14.**	\$326	57 da.
5.	\$700	83 da.	**15.**	\$450	90 da.
6.	\$850	60 da.	**16.**	\$980	95 da.
7.	\$975	90 da.	**17.**	\$860	86 da.
8.	\$50	63 da.	**18.**	\$340	34 da.
9.	\$535	75 da.	**19.**	\$260	26 da.
10.	\$460	32 da.	**20.**	\$500	50 da.

*21. Construct an interest table for \$100 like the one on page 131, using 5% as the rate.

*22. Calculate the interest at 5% in problems 1 to 8, using your interest table.

*23. Make up a problem involving the finding of interest. Solve your problem by use of the interest table.

HOW BANKS PAY INTEREST

On April 30, 1935, Jack had $400 in his savings account. The bank pays interest semiannually, on April 30 and October 31. The rate paid is 2% per annum.

1. If Jack deposited no money after April 30, how much interest was paid by the bank October 31? The rate was 1% for $\frac{1}{2}$ year.

As Jack did not draw out his interest, the bank added it to his principal. Beginning Oct. 31, therefore, he had $404 in the bank.

2. How much is the interest on $404 from Oct. 31, 1935, to April 30, 1936?

3. From April 30, 1936, to Oct. 31, Jack made no deposits. How much had he on deposit during this period?

4. Jack's principal from April 30 to Oct. 31 was $408.04. The interest due Oct. 31 was figured on $408, since savings banks do not pay interest on parts of a dollar. How much interest was due Jack on Oct. 31, 1936?

5. How much will Jack have in the bank on April 30, 1937, if he does not draw out any of his interest?

6. How much interest will Jack's $400 earn in the two years, from April 30, 1935, to April 30, 1937?

You see that Jack received interest on the interest he left with the bank as well as on his original principal of $400. This method of calculating interest is called *compound interest.* In compound interest the principal always increases. If Jack had taken out his interest each six months, he would have received *simple interest* only. A compound-interest table is given on page 259.

7. How much is the simple interest on $400 for three years at 4%?

8. How much less is the simple interest on $400 for three years at 4% than is compound interest paid semiannually? (Use table, p. 259.)

9. Find the compound interest on $500 for two years at 4%, interest paid semiannually. How much less than the compound interest is the simple interest for the same length of time? (Use table, p. 259.)

10. In 15 years $1,000 at 4% amounts to $1,811.36, interest compounded semiannually. How much is the compound interest?

11. How much less is the simple interest on $1,000 for 15 years at 4%?

12. The bank in which Mary deposited her money pays interest quarterly. On October 1 she deposited $100. How much interest is due January 1, if the rate of interest is 4%?

Think: Since interest for 1 year = 4%, for $\frac{1}{4}$ year the interest = 1%.

13. This bank does not pay interest on money deposited after the tenth of the month. How much interest would be paid July 1 on $100 deposited April 20?

Think: Interest would be paid only for May and June. What is the interest on $100 for 2 months at 4%?

14. Helen deposited $50 on April 19 and $75 on May 6. How much interest will she receive on these deposits on July 1, if the interest is paid quarterly at the rate of 4% a year?

***15.** What rate of interest is paid at local banks? Have these banks any special regulations about paying interest?

***16.** Find how bankers compute interest.

Find the compound interest and the amount of the following, compounded annually:

17. \$400; rate, 4%; time, 3 years.

18. \$750; rate, 5%; time, 4 years.

19. \$800; rate, $2\frac{1}{2}$%; time, 3 years.

THE POST OFFICE SAVINGS BANK

Any person may deposit money in the Post Office Savings Bank. According to regulations, the total deposits of each year must not exceed \$1,500, and the maximum balance, not including interest, at the credit of any such account is limited to \$5,000.

A depositor in any of the Savings Bank Post Offices may continue his deposits at any other convenient Savings Bank Post Office, or withdraw his money at them. Each depositor is supplied with a passbook, which must be produced when money is deposited or withdrawn. Each depositor's account is kept in the Postmaster General's office in Ottawa, which makes a direct acknowledgment of each deposit. Each depositor must send his book once a year for insertion of interest and comparison with the books of the department. In a recent year there were deposits amounting to \$24,000,000. There is no charge for paying in or drawing out funds at these banks.

Interest at the rate of 2% is added to the principal on the 31st of March in each year.

Secure information as to the exact procedure in depositing or withdrawing money in the Post Office Saving Bank.

Why do you think that the Post Office Savings Bank is a safe place to deposit money?

REVIEW OF IMPORTANT POINTS

1. How do banks help men in business?

2. How is money raised by taxation used by the local and federal governments?

3. What is the difference between direct and indirect taxes?

4. How is the amount of property taxes found that the owner of a home must pay?

5. What is a tariff?

6. What is the difference between ad valorem and specific duty?

7. What is "overhead" in a business? What is a "margin"?

8. What are three safe ways of sending money to a person in some other city?

9. What is the difference between simple and compound interest? Which kind of interest yields the greater return?

10. How can a man wishing to build a home borrow money to help pay the cost of building it?

11. Name at least ten kinds of insurance.

12. What is an insurance policy?

13. What are fire hazards? How do fire hazards affect the premium rates on buildings?

14. What are the most common causes of destructive fires? What is being done to reduce the loss by fire?

15. How are premiums on fire insurance computed?

16. Explain clearly the differences between the four kinds of life insurance policies.

17. How are life insurance premiums computed?

18. How does a life insurance company use the premiums paid by policyholders?

PROBLEMS FOR DISCUSSION AND REPORT

1. Tell how banks aid the depositor; the community.
2. Tell how banks aid the business man.
3. Are cheques the same as money? Explain.
4. Give some simple rules to follow in drawing a cheque. Explain the reason for each rule you suggest.
5. A thrifty person should keep both a chequing and a savings account. Why?
6. For how much may a safety deposit box be rented in a local bank? What would you put in a safety deposit box?
7. What is the difference between cashier's cheques and certified cheques?
8. What devices may be used to prevent forgery or raising cheques?
9. What difficulties would business men have in paying their bills if there were no banks?
10. Describe different ways in which a business man may pay bills of out-of-town firms.
11. Describe three safe ways of carrying money.
12. In what ways are interest tables time saving?
13. List the important things a bank does for its patrons.
14. Banks are glad to lend money to persons who can give good security. Explain.
15. Why is it a good thing to be a depositor in a savings bank?
16. A bank lends the money deposited with it. Why do not the depositors find people who wish to borrow money and do their own lending?
17. In what ways does a bank make a town or village a safer place in which to live?

PRACTICE TESTS

Practise each set of examples until you can work all of the examples correctly in the time allowed.

PRACTICE TEST IN FRACTIONS III (8 minutes)

1. $3\frac{1}{5} \times 2 =$
2. $7\frac{3}{4} + 3\frac{1}{2} =$
3. $14 \div \frac{4}{5} =$
4. $4\frac{1}{3} - \frac{1}{12} =$
5. $\frac{1}{2}$ of $1\frac{1}{5} =$
6. $7\frac{3}{5} - 1\frac{1}{10} =$
7. $5 \div 2\frac{1}{2} =$
8. $\frac{3}{5} + \frac{1}{2} + \frac{1}{4} =$
9. $3\frac{1}{3} \times \frac{1}{8} =$
10. $3\frac{1}{4} - 1\frac{2}{3} =$
11. $6\frac{1}{4} \times 6\frac{2}{5} =$
12. $13\frac{7}{8} - 8\frac{11}{12} =$
13. $3\frac{1}{3} \div 1\frac{3}{4} =$
14. $7\frac{3}{5} + 7\frac{1}{4} + \frac{1}{4} =$
15. $12 \div 6\frac{3}{5} =$
16. $4\frac{2}{3} - \frac{2}{3} =$

PRACTICE TEST IN DECIMALS III (8 minutes)

1. $.28 + .43 + .95 =$
2. $.43 - .41 =$
3. $7 \times .008 =$
4. $8.4 \div 4 =$
5. $4 \times 3.28 =$
6. $3.26 + .04 + 1.1 =$
7. $.6 - .004 =$
8. $4 \div .7 =$
9. $.4 \times .2 =$
10. $3.748 - 3.7 =$
11. $38 + .3 + .125 =$
12. $87 \div 33 =$
13. $18.2 - 1.625 =$
14. $.972 \div 6 =$
15. $.03 \times 8.04 =$
16. $1.342 \div .11 =$

PRACTICE TEST IN PER CENTS III (8 minutes)

1. $1.2 =$ —%
2. $.125 =$ —%
3. $\frac{1}{8} =$ —%
4. $133\frac{1}{3}\%$ of $60 =$
5. $5 =$ —% of 100
6. $48 = 50\%$ of —
7. $2\frac{1}{2} =$ —% of 10
8. 20% of $65 =$ —
9. $12 = 5\%$ of —
10. $150 =$ —% of 125
11. 8.5% of $400 =$
12. $600 =$ —% of 300
13. $16\frac{2}{3}\%$ of — $= 90$
14. $\frac{1}{2}\%$ of $500 =$
15. 175% of — $= 140$
16. 4% of $\$75 =$

CUMULATIVE TEST IV

You should be able to complete the examples in this test in less than *fifteen minutes.*

1. 581 (*3*) **2.** 175,642 (*3*) **3.** 756 (*3*) **4.** $125\overline{)6{,}740}$ (*3*)
843 −96,478 ×800
300 **5.** $4\frac{1}{8}$ (*12*) **6.** $97\frac{3}{4}$ (*14*) **7.** $4\frac{1}{2} \times 2\frac{2}{3} \times 6 =$ (*17*)
393 $7\frac{1}{4}$ $-46\frac{5}{6}$
830 $+6\frac{1}{3}$ **8.** $3\frac{1}{8} \div \frac{5}{6} =$ (*19*)
549
321 **9.** 73.465 (*25*) **10.** 6.43 (*26*) **11.** $.049\overline{)373.6}$ (*27*)
−9.8 ×.05

12. Find 108% of $48.75. (*34*)

13. 480 = −% of 1,000. (*35*) **14.** $2\frac{1}{2}$% of — = $1.25. (*35*)

15. Find the interest on $475 at 6% for $4\frac{1}{2}$ years. (*129*)

16. Express $\frac{11}{16}$ as a decimal and as a per cent. (*31*)

17. Find the sum of 8.7, .95, 46.2, and .046. (*25*)

18. Subtract 9.74 from 12.6. (*25*)

19. If the list price is $12 and the discounts are 10% and 5%, find the net price. (*87*)

20. Find the rate if sale is $400 and net proceeds $360. (*33*)

21. Find i if $P = \$200$, $t = 60$ days, and $r = 6\%$. (*121*)

22. Find A if l is $5\frac{1}{2}$ ft. and w is $3\frac{1}{3}$ ft. (*145 and Gd. VII*)

23. Find V if l is .6 ft., w is 1.2 ft. and h is 2.5 ft. (*145 and Gd. VII*)

24. Find P if l is $2\frac{3}{4}$ yd. and w is $1\frac{1}{2}$ yd. (*144 and Gd. VII*)

25. Find the tax on $4,000 if the rate is $3\frac{1}{4}$ mills. (*109*)

VOCABULARY EXERCISE

Explain each of the following:

1. margin	**4.** principal	**7.** duty
2. rate	**5.** cheque	**8.** net profit
3. formula	**6.** trade discount	**9.** budget

PROBLEM SCALE III

1. Find the taxes on a house assessed at $4,000, if the tax rate is $4\frac{1}{2}$ mills.

2. Mary had a temperature of 104.2° during a recent illness. How much above normal temperature was this? (98.6° is normal.)

3. How much will moulding for a room 20 feet by 24 feet cost at 12 cents a foot?

4. The interest on a $500 loan for two years was $60. Find the rate of interest.

5. A retail grocer paid a bill of $600, after deducting discounts of 10% and 2%. What was the amount the grocer paid?

6. A new automobile costs $1,560. If automobiles usually depreciate 35% in value the first year and 25% the second year, for how much should it be sold at the end of the second year?

7. On March 5, 1935, J. R. Prevost borrowed $480 to make improvements on his farm, with interest at 6%. What sum should he return to the lender on October 7 of the same year?

8. The duty on 25 yards of cloth, invoiced at $.60 a yard, was 20% ad valorem and 15 cents a yard. Find the total duty on the cloth.

9. What is the value of a farm, $\frac{1}{2}$ mile long and $\frac{1}{4}$ mile wide, at $125 an acre?

10. An electric toaster uses about 8 watts of electricity a minute. How much does it cost to use the toaster for 15 minutes at 10¢ a kilowatt?

SECTION V

HOW TO USE FORMULAS

You have learned to express many arithmetic rules by using letters to represent numbers.

1. Compare the following:

a. **The rule:** *To find the cost of a number of items multiply the price of one item by the number of items purchased.*

b. **The formula:** $c = np$.

A formula is a "shorthand" way of stating a rule.

In the formula $c = np$, what does the letter c represent? the letter n? the letter p? Remember that np is the same as $n \times p$. When we use letters for numbers, we are using *algebra*. In algebra we write letters together, thus, lw, to indicate multiplication. The sign of multiplication ($\times$) is omitted.

2. Show that the formula for stating the following rule is $d = rt$:

To find the distance travelled multiply the rate of speed by the time of travel.

3. State in words the rule for finding the area of a rectangle. Give the formula.

Statements like $A = lw$ and $A = 5 \times 16$, in which one expression is equal to another, are called *equations*.

4. Explain the formula for the perimeter of a rectangle, $p = 2l + 2w$.

5. Explain the formula $A = P + Prt$ for finding the amount of an interest-bearing loan when due.

USING FORMULAS IN ARITHMETIC

Your first step in solving problems is to state briefly what you are to find. This exercise will give you practice in making up formulas about some of our common mathematical situations. First write the correct formula for each of the problems; then solve the problem.

1. A train travelled 4.25 hours at the rate of 37.4 miles an hour. How far did it travel?

2. A passenger train travelled a distance of 158.95 miles in 4.25 hours. What was the speed an hour?

3. How many towels, each $\frac{3}{4}$ yard long, can be cut from a piece of cloth $7\frac{1}{2}$ yards long?

4. Find the perimeter of a rectangle 24 inches long and 12 inches wide.

5. Find the cost of $8\frac{1}{2}$ yards of silk at \$.48 a yard.

6. Find the reduction on a \$25 lamp on sale at a discount of 20%.

7. What is the commission on a sale of \$4,000 if the rate of commission is $2\frac{1}{2}\%$?

8. Find the interest Mr. Ames must pay on \$400 at 6% for 3 months.

9. What is the per cent of reduction on a \$20 chair which was sold for \$15?

10. Find the length of a rectangle whose area is 140 square inches if its width is 10 inches.

11. What is the area of a triangle whose base is 12 inches and height 10 inches?

12. What is the volume of a block of wood 12 inches long, 14 inches wide, and 10 inches thick?

13. Find the area of a parallelogram whose base is 12 inches and altitude 15 inches.

A SELECTION EXERCISE IN FORMULAS

Which of the following statements are correct? Which are incorrect? Give the correct statements in place of any that are incorrect. Express each correct statement as a formula.

1. The cost of a number of books is the price of one book multiplied by the number of books purchased.

2. The area of a rectangle is its length minus its width.

3. The distance travelled equals the rate of speed multiplied by the time travelled.

4. The perimeter of a square equals its length times its width.

5. Rate of speed equals the distance travelled divided by the time.

6. The required time to travel a certain distance equals the rate of speed divided by the distance.

7. Wages equal the amount earned an hour multiplied by the number of hours of work.

8. Wages a day equal earnings a week divided by the number of days.

9. The volume of a solid equals the length times the width times the height.

10. The number of bushels equals the number of quarts divided by 8.

11. The average weight of a number of apples equals their total weight times the number of apples.

12. The price of one quart equals the price of a gallon multiplied by 4.

13. Gain equals cost plus selling price.

14. Loss equals cost minus selling price.

USING LETTERS FOR NUMBERS

State in words the meaning of formulas **1** to **9**:

1. $A = ab$	**4.** $P = 4s$	**7.** $P = 2l + 2w$
2. $A = \frac{1}{2}ab$	**5.** $V = lwh$	**8.** $A = \pi r^2$
3. $C = 2\pi r$	**6.** $i = prt$	**9.** $d = 2r$

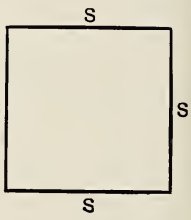
10. If the length of one side of a square is 1 inch, find the perimeter of the square.

Let s represent the number of inches in the length of a side.

$s + s + s + s$ or $4s$ = perimeter or P

$4s = P$

4×1 inch or 4 inches $= P$



11. If the perimeter of a square is 24 inches, what is the length of one side?

Think: $4s = P$

Therefore $4s = 24$

$\frac{4s}{4} = \frac{24}{4}$

$s = 6$

Divide both sides of the equation by 4. You can see that the two sides of the equation are still equal. Hence, one side of the square is 6 inches long.

Find the value of s in the following:

12. $4s = 12$	**15.** $10s = 30$	**18.** $7s = 35.7$
13. $16 = 4s$	**16.** $12 = 6s$	**19.** $9s = 15$
14. $5s = 20$	**17.** $3s = 15$	**20.** $11 = 4s$

In finding the value of a letter in an equation, you are solving the equation. Equations **11** to **20** were solved by *division*.

***21.** If the circumference of a circle is 22 inches, how long is the diameter of the circle? Use $3\frac{1}{7}$ as value of π.

***22.** How long is the diameter of a circle if its circumference is 55 feet? 11 inches? 44 yards? 50 feet?

USING EQUATIONS IN SOLVING PROBLEMS

The method of solving equations by division makes the solution of many problems easier.

1. If the area of a rectangle is 40 square inches and its length is 8 inches, what is its width?

Think: $A = lw$

$40 = 8 \times w$ or $8w$

$\frac{40}{8} = \frac{8w}{8}$ Divide both sides of the equation by 8.

$5 = w$, or $w = 5$

2. The volume of a rectangular tank is 540 cubic feet. Its length is 10 feet and its width 6 feet. Find its height?

Think: $V = lwh$

$540 = 10 \times 6 \times h$ or $60h$

$\frac{540}{60} = \frac{60h}{60}$

$h = ?$

3. The interest on \$500 for two years is \$60. What is the rate of interest?

Think: $i = prt$

$\$60 = \$500 \times r \times 2 = 1{,}000r$

$r = ?$

4. If $i = \$45$, $r = 6\%$, and $t = 2$ years, what is p?

5. If $i = \$30$, $p = \$500$, and $t = 2$ years, what is r?

6. If the area of a rectangle is 16 square feet and its width is 2 feet, what is its length?

7. If Harry's commission is \$50, and his rate of commission is 5%, what is the amount of his sales?

Think: commission = 5% of his sales.

Let c = commission and s = sales

$c = .05s$

$\$50 = .05s \quad ? = s$

8. If $c = \$22.80$, and $r = 4\%$, what is s?

9. If $c = \$36.20$, and $r = 5\%$, what is s?

MAKING EQUATIONS

The solution of a problem may be stated in the form of an equation.

1. Three times a number is equal to 12. What is the number?

Let n stand for the number.
Then, $3\,n = 12$.

2. If 7 is added to a certain number, the sum is 12. What is the number?

Show that $n + 7 = 12$ tells the story of the problem.

3. I spend 10 cents and have 12 cents left. How much money did I have at first?

Show that $c - 10 = 12$ tells the story of the problem.

4. Make equations for the statements below:

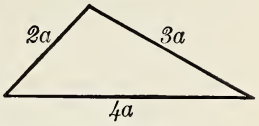
a. Four times a number plus 5 equals 17.
b. Five more than a certain number is 14.
c. Ten less than a number is 6.
d. Six times a number plus 5 equals 35.
e. The cost of a pair of skates plus \$2.00 is equal to \$7.50.
f. Five times a number minus 6 equals 34.
g. A number plus 5 equals 6.
h. Two times a number is the number plus 5.
i. The difference between a number and 9 is 7.

5. Make up a statement for each of the following equations:

a. $n + 4 = 15$
b. $4\,n + 2 = 18$
c. $n - 5 = 12$
d. $c - \$.25 = \$.75$
e. $4\,s = 16$
f. $2\,n + 12 = 6$
g. $i = \$25 \times .06 \times 3$
h. $\$7.20 = p \times .06 \times 2$

USING ALGEBRA AND GEOMETRY TOGETHER

Sometimes it is convenient to let letters represent the lengths of sides of figures, as in this triangle.



1. The perimeter of the triangle equals the sum of the lengths of the three sides, or of $2\,a$, $3\,a$, and $4\,a$. $2\,a + 3\,a + 4\,a = 9\,a$, just as 2 apples + 3 apples + 4 apples = 9 apples.

Find the sums of the following:

2. $2\,a + 3\,a + 2\,a =$ **5.** $4\,c + 2\,c + 3\,c =$

3. $5\,a + 4\,a + 3\,a =$ **6.** $2\,x + 2\,x + 2\,x =$

4. $6\,a + 4\,a + 7\,a =$ **7.** $5\,x + 3\,x + 2\,x =$

8. Find the sum of a, $2\,a$, and $2\,a$.

a means $1\,a$; hence, $a + 2\,a + 2\,a = 5\,a$

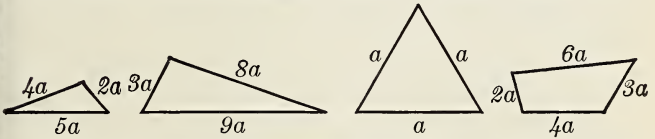
Find the sums of the following:

9. $a + 3\,a + 4\,a =$ **12.** $x + 4\,x + x =$

10. $a + a + 2\,a =$ **13.** $3\,x + x + x =$

11. $a + 4\,a + a =$ **14.** $5\,y + 4\,y + 7\,y =$

15. Find the perimeters of the following in terms of a:



16. If the perimeter of the triangle XYZ is 18 inches, how long is each side?

$2\,a + 3\,a + 4\,a = 18$

$9\,a = 18$

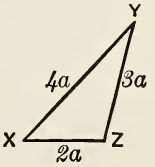
$a = 2$

$2\,a = 4$

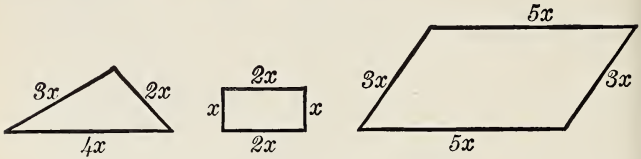
$3\,a = 6$

$4\,a = 8$

Hence, $XZ = 4$, $YZ = 6$, and $XY = 8$.



17. Measure the sides of the following figures with a ruler and find the perimeter of each.

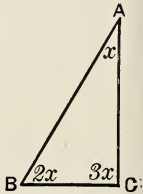


18. Write equations to represent the perimeters of the above figures. Find the value of x in each equation.

19. If $2\,x$, $3\,x$, and $4\,x$ represent the sides of a triangle whose perimeter is 9 inches, what is the length of each side? Construct the triangle. Measure the angles of the triangle with a protractor.

Using Algebra to Find the Sizes of Angles

Suppose that you wish to find the values of the angles in triangle ABC. The sizes of the angles are expressed by x, $2\,x$, and $3\,x$. How can you find the size of each angle?



In the seventh grade you learned that the sum of the three angles of a triangle equals 180°.

Hence, angle A + angle B + angle C = 180°
Then, $x + 2\,x + 3\,x = 180°$
Adding, $6\,x = 180°$
Dividing, $x = 30°$, angle A
$2\,x = 60°$, angle B
$3\,x = 90°$, angle C

Show that angle A + angle B + angle C = 180°.

Check also by measuring the angles in the triangle with a protractor.

Find the value of x in the following equations:

1. $x + 3x + 4x = 180°$ **5.** $x + x + x = 180°$

2. $2x + x + 4x = 140°$ **6.** $4x + 3x + x = 180°$

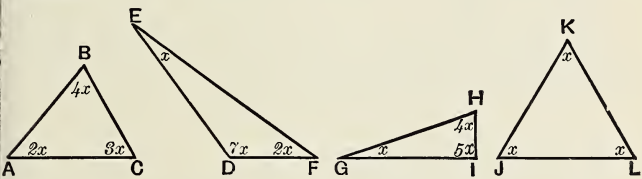
3. $3x + 4x + 2x = 180°$ **7.** $x + x + 4x + 3x = 360°$

4. $3x + x + 4x = 180°$ **8.** $2x + 3x + x = 180°$

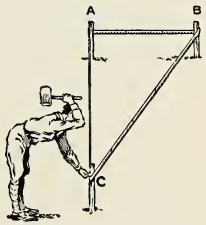
9. $5x + 6x + 8x + 6x = 360°$

10. $4x + 2x + x + 5x + 4x + 4x = 360°$

11. Find the sizes of the angles in each of the following triangles:



12. In the picture, David has driven two stakes into the ground 3 feet apart and has attached the zero end of a measuring tape to stake A and the 9-foot mark on the tape to stake B. He has grasped the tape at the 4-foot mark, pulled taut, and is driving stake C into the ground exactly at the 4-foot mark on the tape. David knows that the line AC is at right angles to AB. Mechanics sometimes use this method to lay off right angles. Lay off a right angle by David's method.



13. Construct a triangle whose sides are 3 inches, 4 inches, and 5 inches. Is one of the angles of this triangle a right angle?

SOLVING EQUATIONS BY SUBTRACTION

1. What number added to 5 equals 11?

The equation is:

$n + 5 = 11$ Think, 5 and what number = 11?

$n = 6$ You can see that 5 and 6 = 11.

2. If we subtract the same number from both sides of an equation, the terms are still equal. This can be seen from the following:

18 lb.	= 18 lb.	Take 4 lb. from each side of a balanced
−4 lb.	= −4 lb.	scale and there is still a balanced scale.
14 lb.	= 14 lb.	

Another way to solve this equation is to subtract 5 from each side of the equation, thus:

$$n + 5 = 11$$
$$n + 5 - 5 = 11 - 5$$
$$n = 6$$

Solve these equations by subtracting the same number from each side of the equation:

3. $n + 4 = 12$

4. $n + 7 = 15$

5. $n + 9 = 11$

6. $n + 4 = 21$

7. $4 + n = 15$

8. $n + \frac{1}{2} = \frac{3}{4}$

9. $n + .5 = 3.5$

10. $n + 2\frac{1}{2} = 4$

11. $3 + n = 7$

12. $n + 1\frac{1}{5} = 6$

13. $5 + n = 7$

14. $n + 16.5 = 37.2$

15. Two boys, each weighing 110 pounds, are on a teeter board. They balance each other. If 10 pounds are taken from the end of one side and 4 pounds from the end of the other, will the teeter balance?

16. A grocer sold sugar at 1.2 cents more a pound than he paid for it. If the selling price was 7.2 cents a pound, what was the cost? Let c represent the cost.

17. A certain number plus 6 equals 12. What is the number?

SOLVING EQUATIONS BY ADDITION

1. What number less 7 is equal to 30?

The equation is:

$n - 7 = 30$
$n = 37$

Think: The number must be 7 more than 30, or 37.

This equation may be solved by adding 7 to each side of the equation, thus:

$n - 7 = 30$
$n - 7 + 7 = 30 + 7$
$n = 37$

Adding 7 to each side of the equation reduces the left side to n.

Show with a pair of balances that the same weight may be added to both sides without disturbing the balance.

Solve these equations by adding the same number to each side of the equation:

2. $n - 6 = 12$
3. $n - 2 = 15$
4. $n - \frac{1}{2} = \frac{1}{2}$
5. $a - 5 = 7$
6. $a - 6 = 15$
7. $n - 3 = 5$
8. $n - 1.5 = 2$
9. $n - 3\frac{1}{2} = 7$
10. $n - 1\frac{1}{4} = 4$
11. $n - 2.5 = 6.5$
12. $n - 3 = 8$
13. $b - 4 = 6$
14. $c - 6 = 12$
15. $d - 8 = 15$
16. $f - 6.7 = 8.4$

17. John is thinking of a number. If he subtracts 8 from it, the remainder is 28. Write an equation and find the number.

Practice in Solving Equations

Find the values of the letters in the following:

1. $4s = 16$
2. $n + 6 = 15$
3. $b - 5 = 10$
4. $5a = 15$
5. $c - 6 = 8$
6. $2a = 6$
7. $n + 7 = 16$
8. $6a = 15$
9. $n - 3.5 = 6.5$
10. $n + \frac{1}{2} = 3\frac{1}{2}$
11. $n + 3 = 5$
12. $n - 3\frac{1}{4} = 6\frac{3}{4}$
13. $8c = 16$
14. $c - 6 = 80$
15. $4 + n = 9$

16. Which of the equations above are solved by addition? by subtraction? by division?

SOLVING EQUATIONS BY MULTIPLICATION

The equation $\frac{n}{3} = 12$ represents the statement, "One third of a number equals 12." You can see that the number must be 3×12, or 36.

Another way to find the value of n is to multiply both sides of the equation by 3, thus:

$$\frac{n}{3} = 12$$
$$3 \times \frac{n}{3} = 3 \times 12$$
$$n = 36$$

Multiplying both sides of an equation by the same number does not change the value of the equation.

Solve these equations:

1. $\frac{n}{5} = 10$	**4.** $\frac{n}{5} = 9$	**7.** $\frac{n}{4} = \frac{3}{4}$
2. $\frac{n}{3} = 6$	**5.** $\frac{n}{4} = 2\frac{1}{2}$	**8.** $\frac{n}{5} = 1\frac{1}{2}$
3. $\frac{n}{2} = 8$	**6.** $\frac{n}{3} = \frac{1}{3}$	**9.** $\frac{n}{6} = \frac{3}{8}$

10. If $\frac{1}{3}\,n = 25$, find n. **11.** If $\frac{2}{3}\,n = 18$, find n.

Practice in Solving Equations

Solve these equations:

1. $4s = 12$	**7.** $18 = 4a$	**13.** $2a = 1\frac{1}{2}$
2. $x + 5 = 7$	**8.** $5x = 15$	**14.** $\frac{n}{5} = 7$
3. $n - 5 = 4$	**9.** $b - 4 = 7$	**15.** $3 + x = 6$
4. $\frac{x}{6} = 8$	**10.** $x + 5 = 6$	**16.** $n - 5 = 4$
5. $p + 4 = 8$	**11.** $\frac{n}{4} = \frac{1}{2}$	**17.** $\frac{n}{2} = \frac{3}{4}$
6. $16 = 7 + p$	**12.** $7 = n - 5$	**18.** $5s = 7.5$

19. Which of the equations on page 152 are solved by addition: by subtraction? by multiplication? by division?

***20.** Write eight equations, two of which may be solved by addition, two by subtraction, two by multiplication, and two by division. Solve each equation.

PICTURING EQUATIONS

This exercise will show you how to picture different kinds of equations.

1. Figure 1 is a picture of the equation $4x = 12$. Find the value of x.

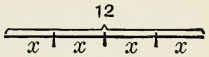


Fig. 1

2. Figure 2 is a picture of the equation $x - 4 = 16$. Find the value of x.

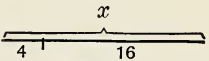


Fig. 2

3. Figure 3 is a picture of the equation $x + 5 = 20$. Find the value of x.

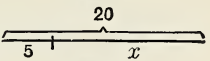


Fig. 3

4. Figure 4 is a picture of the equation $\frac{x}{3} = 6$. Find the value of x.

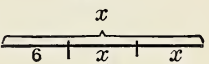


Fig. 4

Draw figures to represent each of the following equations and find the value of x:

5. $3x = 9$

6. $x - 2 = 6$

7. $x + 3 = 5$

8. $\frac{x}{2} = 4$

9. $x - 3 = 7$

10. $5x = 10$

11. $\frac{x}{4} = 2$

12. $x + 3 = 6$

13. $\frac{x}{3} = 8$

14. $x - 4 = 6$

15. $2 + x = 9$

16. $2x = 8$

IMPORTANT PRINCIPLES OF EQUATIONS

You have studied four important mathematical laws which are used in solving equations.

a. If the same number is added to each side of an equation, the equality of the two sides is not altered.

b. If the same number is subtracted from each side of an equation, the equality of the two sides is not altered.

c. If both sides of an equation are multiplied by the same number, the equality of the two sides is not altered.

d. If both sides of an equation are divided by the same number, the equality of the two sides is not altered.

1. What must be done to change $x + 5 = 7$ to $x = 2$?

2. What must be done to change $\frac{x}{4} = 7$ to $x = 28$?

3. What must be done to change $a - 5 = 6$ to $a = 11$?

4. What must be done to change $4s = 12$ to $s = 3$?

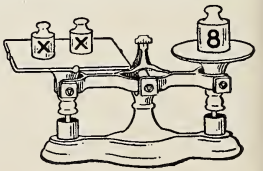
5. What principle is used in solving each of the following?

a. $7x = 14$ ***c.*** $\frac{n}{5} = 2$ ***e.*** $3x = 18$

b. $x - 5 = 4$ ***d.*** $s + 4 = 6$ ***f.*** $\frac{x}{2} = 7$

6. What principle is used in finding the value of x in this equation? $\frac{x}{5} = \frac{8}{15}$

***7.** Draw pictures showing that the four principles listed at the beginning of this exercise are correct. For example: which principle is illustrated by the picture of the scales at the right? Which principle represents the equation $2x = 8$ lb.



COMMISSION

Rule: To find a salesman's commission on a sale of goods multiply the money received for the sale by the rate of commission.

Formula: $c = rs$. Explain.

1. If $r = 5\%$ and $s = \$70$, find c.

Think: $c = .05 \times \$70 = ?$

2. If $c = \$10$ and $r = 4\%$, find s.

Think: $\$10 = .04 \times s$.

$\$10 = .04\ s$.

$s = ?$ Solve for s by dividing both sides by .04.

3. If $c = \$10$ and $s = \$100$, find r.

Think: $\$10 = r \times 100 = 100\ r$.

$\$10 = 100\ r$.

$r = ?$ Find r by dividing both sides by 100.

Using the facts given below write the equation to be solved to find the missing letter, using the formula $c = rs$. Then find the value of the missing letter.

	c	r	s
4.	\$10	5%	?
5.	\$20	4%	?
6.	\$30	?	\$150
7.	\$40	?	\$800
8.	?	6%	\$900
9.	?	8%	\$750
10.	\$30	6%	?
11.	\$45	?	\$900
12.	?	12%	\$800

Write a commission problem illustrating each of these types.

SOLVING THE INTEREST FORMULA

You have learned the interest formula, $i = prt$. You can use this formula to solve many interest problems.

1. If $i = \$72$, $p = \$720$, $r = 5\%$, find t.

Think: $\$72 = 720 \times .05 \times t$.

Multiply: $72 = 36\,t$. Find t.

2. If $i = \$72$, $p = \$720$, $t = 2$ yr., find r.

Think: $72 = 720 \times r \times 2$.

Multiply: $72 = 1{,}440\,r$. Find r.

3. State in your own words a problem in which you would have to find p. Use this algebraic method to find the missing values in the table below. Show the equation.

	i	p	r	t
4.	\$100	\$1,000	?	2 yr.
5.	\$320	\$4,000	4%	?
6.	\$300	?	6%	2 yr.
7.	\$450	?	5%	3 yr.
8.	\$216	\$1,800	?	2 yr.
9.	\$30	\$250	4%	?
10.	\$120	?	3%	4 yr.
11.	\$72	\$480	?	3 yr.
12.	\$90	\$750	4%	?

13. How much money must I invest at 6% to get a yearly return of \$720?

14. Mr. Jones loaned me \$1,000. In two years I paid him \$90 interest. What was the rate of interest?

15. I loaned Mr. Jones \$750 at 6% a year. After a time I paid him \$22.50 interest. How long was the time?

SOLVING EQUATIONS BY MORE THAN ONE PROCESS

Sometimes more than one process must be used in solving an equation.

1. The length of a rectangle is 6 feet. Its perimeter is 20 feet. What is the width of the rectangle?

Substitute values for letters in the formula $2\,l+2\,w=P$:

$$\begin{aligned} 12+2\,w &= 20 \\ -12 &= -12 \\ \hline 2\,w &= 8 \\ w &= 4 \end{aligned}$$

a. First subtract 12 from each side of the equation, leaving $2\,w = 8$.

b. Divide each side of the equation by 2. The result shows that $w = 4$.

Subtraction and division were needed in solving this equation.

2. The equation $5\,n - 4 = 16$ is solved thus:

$$\begin{aligned} 5\,n - 4 &= 16 \\ +4 &= +4 \\ \hline 5\,n &= 20 \\ n &= 4 \end{aligned}$$

a. Adding 4 to each side of the equation gives the equation $5\,n = 20$.

b. Divide each side of the equation by 5. The result shows that $n = 4$.

What two processes were used in solving this equation?

3. Solve the equation $\frac{5\,n}{3} - 4 = 16$.

$$\begin{aligned} \frac{5\,n}{3} - 4 &= 16 \\ +4 &= +4 \\ \hline \frac{5\,n}{3} &= 20 \\ \cancel{3} \times \frac{5\,n}{\cancel{3}} &= 3 \times 20 \\ 5\,n &= 60 \\ n &= 12 \end{aligned}$$

a. Adding 4 to each side of the equation gives the equation $\frac{5\,n}{3} = 20$.

b. Multiplying both sides of the equation by 3 gives the equation $5\,n = 60$.

c. Dividing both sides of the equation by 5 gives the equation $n = 12$.

Solve the following equations:

4. $2\,l + 10 = 30$

5. $2\,w + 15 = 19$

6. $6\,n - 8 = 28$

7. $2\,n - 3 = 7$

8. $\frac{1}{2}\,n - 4 = 6$

9. $\frac{2}{3}\,n + 7 = 21$

PRACTICE IN SOLVING EQUATIONS

The steps in solving an equation are: add or subtract as necessary; then multiply and, if necessary, divide.

Solve the following equations:

Set I (adding and dividing)

1. $4x - 7 = 17$ **3.** $5b - 4 = 21$ **5.** $8n - 12 = 20$

2. $3a - 5 = 22$ **4.** $7p - 8 = 6$ **6.** $4p - 3 = 13$

Set II (subtracting and dividing)

7. $3x + 4 = 10$ **9.** $4n + 7 = 19$ **11.** $6c + 4 = 22$

8. $5a + 3 = 28$ **10.** $5b + 2 = 37$ **12.** $7c + 5 = 54$

Set III (three steps)

Decide first whether you must add or subtract; then continue with multiplication and division as needed.

13. $\frac{n}{5} + 4 = 6$ **15.** $\frac{2n}{5} + 7 = 9$ **17.** $\frac{n}{4} - 7 = 3$

14. $\frac{n}{6} - 3 = 5$ **16.** $\frac{3a}{5} - 6 = 6$ **18.** $\frac{3n}{7} - 5 = 4$

Set IV (all types of equations)

19. $n + 5 = 6$ **26.** $\frac{n}{3} - 6 = 8$ **33.** $5a = 16$

20. $\frac{n}{4} = \frac{8}{16}$ **27.** $\frac{3n}{4} - 2 = 7$ **34.** $a - 3\frac{1}{2} = 5$

21. $n - 5 = 2$ **28.** $\frac{4a}{5} + 4 = 12$ **35.** $2a + 4 = 12$

22. $3a = 12$ **29.** $a - 6 = 15$ **36.** $5a - 7 = 13$

23. $2a - 3 = 9$ **30.** $12 = 4 + b$ **37.** $\frac{n}{3} + 4 = 6$

24. $4a + 5 = 25$ **31.** $\frac{c}{3} = \frac{8}{12}$ **38.** $\frac{n}{4} - 5 = 3$

25. $\frac{n}{5} + 4 = 7$ **32.** $\frac{n}{2} + 5 = 14$ **39.** $\frac{4n}{3} + 4 = 12$

SOLVING PROBLEMS BY EQUATIONS

1. The formula for finding the distance when the rate of speed and the time are known is $d = rt$.

a. Find d, if $r = 6$ and $t = 8$.

b. Find r, if $d = 40$ and $t = 2$.

c. Find t, if $d = 180$ and $r = 30$.

2. The formula for the area of a triangle is $A = \frac{1}{2}ab$.

a. Find A, if $a = 6$ and $b = 4$.

b. Find a, if $A = 40$ and $b = 8$.

c. Find b, if $A = 30$ and $a = 5$.

3. The perimeter of a rectangle is found with the formula, $P = 2l + 2w$.

a. Find P, if $l = 6$ and $w = 8$.

b. Find l, if $P = 16$ and $w = 4$.

c. Find w, if $P = 24$ and $l = 5$.

4. The formula for finding the circumference of a circle is $C = \pi d$, or $3\frac{1}{7}d$.

a. Find C, if $d = 7$ inches.

b. Find d, if $C = 44$ inches.

5. The formula for the perimeter of a triangle is $P = a + b + c$, when a, b, and c represent the sides.

a. Find P, if $a = 3$ in., $b = 1\frac{1}{2}$ in., and $c = 3\frac{1}{2}$ in.

b. Find a, if $P = 14$ in., $b = 6$ in., and $c = 4$ in.

c. Find c, if $P = 12$ in., $b = 4\frac{1}{2}$ in., and $a = 3\frac{3}{4}$ in.

6. The formula for finding the net profit is: *net profit = selling price minus total cost, or* $p = s - c$.

a. Find p, if $s = \$140.25$ and $c = \$120.15$.

b. Find s, if $p = \$.36$ and $c = \$9.44$.

c. Find c, if $p = \$1.25$ and $s = \$16.20$.

7. The formula for the amount of a note is $A = P + Prt$.

a. Find A, if $P = \$200$, $r = 6\%$, $t = 60$ days.

USING EQUATIONS IN SOLVING PROBLEMS

1. Arthur and his young brother Harry earned \$12 mowing lawns. Arthur was to receive twice as much as Harry. How much did each boy receive?

Let x = number of dollars in Harry's share.
Then, $2x$ = number of dollars in Arthur's share. Why?
By adding x and $2x$, find the number of dollars both earned.

$$x + 2x = 12$$
$$3x = 12 \qquad \text{Solve by dividing each side of}$$
$$x = 4 \qquad \text{the equation by 3.}$$

Since $x = 4$, $2x = 8$. Therefore Harry receives \$4.00 and Arthur \$8.00 *Check:* $4 + 8 = 12$.

2. Alice weighs x pounds. Her father weighs three times as much. How can you express her father's weight? the weight of both?

3. A mixture of corn and wheat weighed 30 pounds. If the mixture contained twice as many pounds of corn as of wheat, find the weight of each.

4. Jack wishes to saw a 9-foot board into two parts. One part is to be two times as long as the other. How long should each part be?

5. A sailboat and a motor boat together cost \$800. The motor boat cost \$100 more than the sailboat. Find the cost of each.

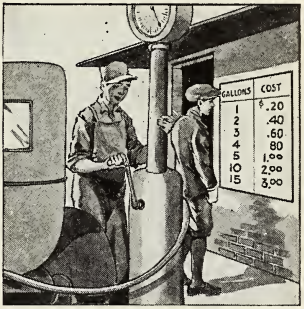
6. A tablet and pencil together cost \$.15. The pencil cost \$.05 less than the tablet. Find the cost of each.

7. The length of a rectangle is 2 inches more than its width. If the perimeter of the rectangle is 16 inches, what are its dimensions?

*8. Make up a problem which you can solve by using equations.

*DRAWING A GRAPH OF A FORMULA

At a gasoline station Arthur saw a sign like the one at the right giving the prices of various amounts of gasoline at \$.20 a gallon. In order to find these prices the formula $c = np$ was used. Is the sign correct?

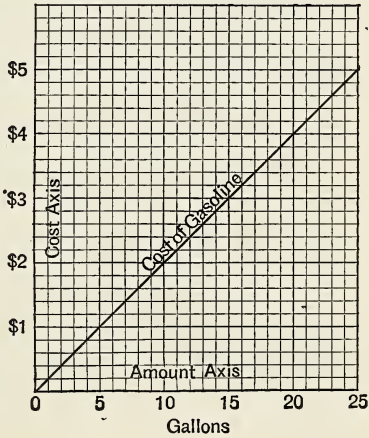


Arthur is reading the prices of various amounts of gasoline at 20 cents a gallon.

1. Use the formula $c = np$ to find the cost of 20 gallons of gasoline at 20¢ a gallon.

2. Show that the formula $c = .20\,n$ may be used to find the cost of any number of gallons of gasoline at \$.20 a gallon.

Another way to find the cost of different amounts of gasoline is to make a graph of the formula $c = .20\,n$ so that you can read the cost from the graph.



On a piece of graph paper draw a heavy horizontal line near the bottom of the sheet, and a heavy vertical line near the left margin. Call the horizontal line the *amount axis*. On this mark off the number of gallons,

using one small square to represent one gallon. Number every fifth square. What does each large square represent?

Call the vertical line the *cost axis*. Let each large square represent \$1.00. Each small square represents how much?

Follow out on the amount axis a distance of one small square, which represents one gallon, and count up one small square, which represents \$.20, the cost of one gallon. Make a dot at this point. In the same way locate dots to represent the cost of 2 gallons; of 5 gallons; of 10 gallons; of 20 gallons. Draw a line connecting these points. This graph is a picture of the formula $c = .20\,n$.

3. Use the graph to find the cost of 8 gallons of gasoline; of 12 gallons; of 15 gallons; of 18 gallons.

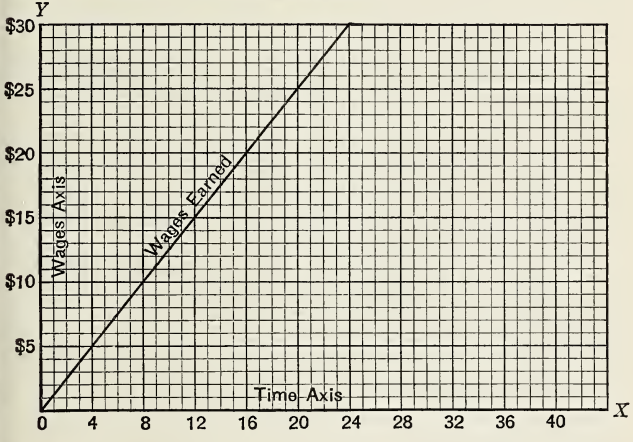
4. Use the graph to find the number of gallons of gasoline you can buy for \$1.00; for \$1.60; for \$3.00.

5. If oil costs 25 cents a quart, write a formula for the price of oil and draw a graph of the formula.

6. A department store in a large city advertised a brand of laundry soap at "5 cents a bar whether you buy one bar or 1,000 bars." Write a formula for the price of a bar of this soap. On graph or cross-section paper draw a graph of the formula. Indicate by heavy dots on the graph the cost of 10 bars, 20 bars, 30 bars, and so on up to 100 bars of soap.

In mathematics whenever one quantity depends for its value on another quantity, the first quantity is called a *function* of the second. A graph like the one on page 161 is called a *function* graph. It shows how the cost of the gasoline depends on the number of gallons bought. The cost of the gasoline is a function of the number of gallons purchased.

The graph below represents the amount of wages earned by a mason who received \$1.25 an hour. This is shown by the formula $w = \$1.25\ h$.



7. How many hours does each space on the time or *X-axis* represent? How much does each space on the cost or *Y-axis* represent?

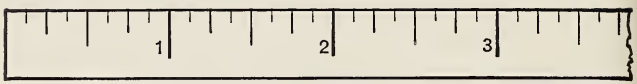
8. How much would the mason receive for 6 hours of labour? for 10 hours? for 16 hours?

9. In how many hours could the mason earn \$10? \$12.50? \$20?

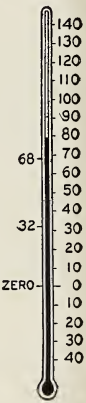
10. If the hodcarrier, who carried bricks and mortar to the mason, received 60 cents an hour, write a formula to represent his wage.

***11.** Construct a graph to represent the hodcarrier's wages. Make a heavy dot on the graph to show the wage for 4 hours, 8 hours, 12 hours, and so on up to 44 hours.

*EXPRESSING DIFFERENCES IN TEMPERATURE



1. Compare the scale on the foot rule with the scale on the thermometer below. What important difference do you see?



2. On the thermometer show where the mercury would stand at 20° above zero; at 4° above zero; at 10° below zero.

3. We can write "10 degrees below zero" in a shorter way, like this: $-10°$. The *minus* sign means that the reading is below zero. Write the following in the short way: Six degrees below zero; nine degrees below zero; $2\frac{1}{2}$ degrees below zero.

4. The number -10 is called a *negative* number. The sign $-$ tells us this. We may write 6 degrees above zero like this: $+6°$. The $+$ shows that the reading is above zero, or *positive*. Usually, however, the plus sign is not written. Write, using $+$ and $-$ signs: 7 degrees above zero; 3 degrees below zero; *negative* 6; *positive* 50.

5. Note on the thermometer scale that $+10°$ and $-10°$ are located in opposite directions from zero. How many degrees apart are $+10°$ and $-10°$?

6. Draw a 20-inch horizontal line on the blackboard. On it place dots at intervals of an inch. Call the middle dot *zero* on a scale. Call the space at the right of the zero point *positive* and the space at the left *negative*. Show where positive five is on the scale; negative six; $+8$; -8.

7. How many inches on the scale separate + 4 and + 6? + 5 and − 5?

8. This table shows the temperature during one morning in a town in Manitoba:

6 o'clock, − 16°	8 o'clock, − 4°	10 o'clock, 11°
7 o'clock, − 10°	9 o'clock, 1°	11 o'clock, 18°

How many degrees did the temperature rise between 6 o'clock and 9 o'clock? between 9 and 11 o'clock?

*USES OF POSITIVE AND NEGATIVE NUMBERS

1. Mr. Smith lost $600 in his business during one month. We may express his loss as − $600. If the next month he lost $300, how much did he lose in the two months?

− $600 − $300 − $900	You know from arithmetic that he lost $900 in all. To find this you added two negative numbers.

2. Carl has $5. He buys a bicycle for $25. How much is he in debt? $5 − $25 = − $20. Why is it correct to call his debt a negative amount?

3. On a test of 10 items, Mary had 5 correct and 5 incorrect. She was penalized 2 points for each incorrect item and was given 1 point for each correct item. What was her score?

4. The surface of a lake is 120 feet above sea level. The bottom of the lake is 50 feet below sea level. How deep is the lake?

5. If we represent the date of the discovery of America (A.D. 1492) by + 1492, and the date of one of the first Olympic games (500 B.C.) by − 500, how many years apart are these two events?

ALCOHOL IN AUTOMOBILE RADIATORS

During the wintertime when the temperature falls below the freezing point (32° F.), the water in automobile radiators will freeze unless it is mixed with some liquid that does not freeze until a much lower temperature is reached. The liquid most commonly used for this purpose is alcohol. Engineers have worked out the following table, which shows the per cent of alcohol there must be in a radiator at each level of temperature to prevent freezing.

Temperature	Per cent of Alcohol
25	10
20	15
15	20
10	25
0	30
−10	35
−15	40

1. In 4 gallons of a 25% mixture of water and alcohol, what is the amount of alcohol?

2. If 6 quarts of alcohol were poured into a radiator containing 12 quarts of water, what would be the per cent of alcohol in the total mixture?

3. A chauffeur poured 2 quarts of alcohol into a radiator containing only water. The mixture was then 20% alcohol. How much liquid was there then in the radiator?

4. If there are $2\frac{1}{2}$ gallons of water in a radiator and a temperature of 10° above zero is predicted, how much alcohol should be poured into the radiator to prevent freezing?

5. Referring to the table, tell how much alcohol it is necessary to have in a 4-gallon mixture of alcohol and water to prevent its freezing at 10°; at 15°; at 25°.

***6.** At what temperature will a mixture of 13 gallons of water and 7 gallons of alcohol freeze?

***7.** At what temperature does alcohol freeze?

*MEASURING HEAT

The illustrations represent three different types of instruments to measure heat. Figure 1 is a Fahrenheit thermometer. This is the kind we ordinarily use in our homes to record room temperatures and outdoor temperatures. The one in the middle is used frequently by scientists. You will use it in the laboratory in your high school. The main difference between these two thermometers is the location of the freezing and boiling points of water.

	Fahrenheit Thermometer	Centigrade Thermometer
Boiling point.....	212°	100°
Freezing point	32°	0°

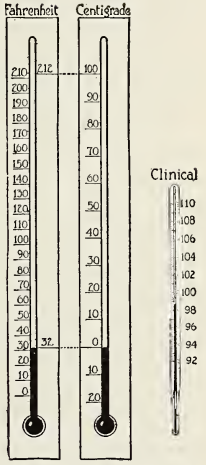


Fig. 1 Fig. 2 Fig. 3

On a centigrade thermometer (Fig. 2) the space between the freezing and the boiling points of water is divided into 100 equal parts called degrees. The freezing point is 0.

On the Fahrenheit thermometer the boiling point of water is 212° above zero; the freezing point is 32° above zero. The space between the freezing and boiling points is divided into 180 parts, or degrees.

Therefore 100 degrees on the centigrade thermometer equals 180 degrees on the Fahrenheit thermometer, or,

$$1^\circ F = \tfrac{5}{9}^\circ C.$$

To change from Fahrenheit to centigrade, we must remember that the freezing point on the Fahrenheit thermometer is 32° above zero. Then,

$$C = \tfrac{5}{9}(F - 32), \text{ and } F = \tfrac{9}{5}C + 32.$$

Example: Change 113° Fahrenheit to centigrade.

SOLUTION

$C = \frac{5}{9}(F - 32)$

$C = \frac{5}{9}(113 - 32)$

$C = \frac{5}{9}$ of 81

$C = +45°$

Example: Change 40° C. to F.

SOLUTION

$F = \frac{9}{5}C + 32°$

$F = \frac{9}{5}\,40° + 32°$

$F = 72° + 32°$

$F = 104°$

Figure 3 (page 167) is a clinical thermometer such as the doctor uses in taking a person's temperature. It is graduated in Fahrenheit degrees, and has a very fine column of mercury in it. When it is placed under the tongue, the mercury rises to the temperature of the body. When the thermometer cools, the mercury thread breaks, leaving the column of mercury at the highest point it has reached. The nurse or doctor can read the temperature a long time after the thermometer has been taken from the mouth. The doctor shakes the mercury down after he has read the thermometer. Note that the scale runs from 92° to 110°. The proper temperature of the body is about 98.6° F.

1. Keep a record of the temperatures of the classroom and also the temperatures of the air outdoors for a week. Express the temperatures in the centigrade scale.

2. Perhaps your teacher will secure from your high-school science room a centigrade thermometer. Compare it with a Fahrenheit thermometer.

3. Determine the following facts from a Fahrenheit thermometer:

a. How many degrees are there between 35° F. and 70° F.? What arithmetical operation gives you this result?

b. How many degrees separate − 10° F. and + 40° F.? What arithmetical operation gives you this result?

EVERYDAY PROBLEMS

1. If a $\frac{1}{4}$-inch square represents an acre, how many acres will a 2-inch square on the same scale represent?

2. A ton of Pocahontas coal cost \$14.50 in December, which was \$2.00 more than the price in September. What was the per cent of increase over the September price?

3. A grocer sold potatoes for \$1.38 a bushel, which was \$.18 a bushel more than he paid for them. What per cent of the cost was the selling price?

4. A motorist put 15 gallons of gasoline into his empty gas tank and noted that his speedometer reading was 9,064 miles. When his gauge showed that $2\frac{1}{2}$ gallons of gasoline were left in the tank, his speedometer reading was 9,212 miles. What was his mileage a gallon?

5. Each of six corn-club boys had a 10-acre field planted to corn. Their yields averaged $82\frac{1}{2}$ bushels of corn to the acre. Yields taken from six average fields in the community average $39\frac{1}{2}$ bushels to the acre. What per cent of the yield an acre of the club boys' fields was the yield of the average fields?

6. How many times as much as the yield of the average community fields was the average of the club boys' fields?

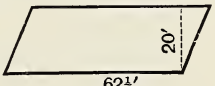
7. Mr. Jones was paid $12\frac{1}{2}\%$ commission on his sales. His sales for one week were as follows:

Monday..	\$98.60	Wednesday..	\$65.25	Friday....	\$84.00
Tuesday..	194.75	Thursday...	76.90	Saturday..	175.75

How much was his commission for the week?

8. Another week his commission was \$64.80. What was the amount of his sales for that week?

9. Find the area of the parallelogram at the right.



REVIEW OF IMPORTANT POINTS

1. What is a formula?

2. What is an equation?

3. Give seven formulas and explain each.

4. Solve for x in the following equations:

a. $5x = 20$ *b.* $50x = 130$ *c.* $x + 7 = 15$

d. $x - 6 = 12$ *e.* $\frac{x}{3} = 9$ *f.* $\frac{x}{4} = \frac{1}{2}$

g. $x + 4x + 2x = 140$ *h.* $\$60 = \$500 \times x \times 2$

5. Solve for x in the following equations:

a. $4x - 7 = 17$ *d.* $\frac{x}{8} = \frac{4}{5}$

b. $3x + 4 = 10$ *e.* $\frac{2x}{5} + 7 = 9$

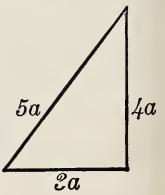
c. $7x + 5 = 33$ *f.* $\frac{3x}{7} - 5 = 4$

6. Find l in the formula $P = 2l + 2w$ if P equals 18 inches and w equals 4 inches.

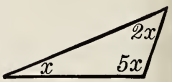
7. Find t in the formula $i = Prt$ if i equals \$6.00, P equals \$100, and r equals 6%.

8. At what rate of interest must \$1,000 be invested if the return must equal \$80 a year?

9. If the perimeter of a flower bed represented by the triangle at the right is 36 feet, what is the length of each side?



10. Find the number of degrees in each angle of the triangle at the right. Measure the angles with a protractor to check your computations.



11. Draw a graph of the wages formula, $w = rh$, if the rate of pay is \$1.00 an hour.

CUMULATIVE TEST V

You should be able to work all of the examples in this test in less than *fifteen minutes.*

1. 773 (*3*) **2.** 91,210 (*3*) **3.** 648 (*3*)
173 −74,563 ×590
790
879 **5.** $8\frac{2}{3}$ (*12*) **6.** $57\frac{2}{3}$ (*14*) **7.** $3\frac{1}{2} \times 2\frac{2}{3} \times 4\frac{1}{2} =$
720 $7\frac{1}{2}$ $-46\frac{3}{4}$
246 $+6\frac{1}{12}$ **8.** $6\frac{2}{3} \div \frac{8}{9} =$ (*19*)
660

79.4 (*25*) **10.** 4.86 (*26*)
9. −25.375 × .46 **11.** 5.7)437.76 (*27*)

12. $33\frac{1}{3}\%$ of 990 = (*34*) **13.** 750 = 120% of ? (*35*)
14. \$7.50 = —% of \$25. (*35*)
15. Add: 5 ft. 6 in., 7 ft. 2 in., 8 ft. 7 in. (*28*)
16. Add 5.75, 6.0, .275, and 174.2. (*25*)
17. Express as decimals: *a.* $\frac{7}{8}$ *b.* $2\frac{1}{2}\%$ (*34*)
18. Use a short-cut method to multiply the following by 25; by 50; by $33\frac{1}{3}$: *a.* 60 *b.* 240 *c.* 84 (*26*)
19. Find $\frac{1}{2}$ of 7.462. (*27*)

Solve for x in the following:

20. $x+5=27$ (*150*) **22.** $\frac{x}{5}=\frac{15}{20}$ (*152*) **24.** $3x+5=9$ (*157*)

21. $x-4=17$ (*151*) **23.** $\frac{x}{3}=9$ (*152*) **25.** $2x-3=7$ (*157*)

VOCABULARY EXERCISE

Give the meaning of each of the following:

ad valorem	volume	altitude	premium
note	policy	section of land	assessed value
commission	principal	protractor	graph

PRACTICE TESTS

Practise each set of examples until you can work all of the examples correctly in the time allowed. Keep a record of your daily scores. Try to beat your record on previous practice tests.

PRACTICE TEST IN FRACTIONS IV (8 minutes)

1. $2\frac{1}{4} + \frac{1}{4} + 4$
2. $7\frac{5}{6} - \frac{1}{6}$
3. $15 \div \frac{5}{6}$
4. $6 \times 3\frac{3}{4}$
5. $\frac{3}{5} \div \frac{3}{5}$
6. $3\frac{3}{4} \times 3\frac{1}{3}$
7. $5\frac{5}{6} + 9\frac{5}{6}$
8. $2\frac{1}{8} - \frac{1}{8}$
9. $4\frac{1}{8} \div \frac{3}{4}$
10. $\frac{5}{8}$ of $6\frac{2}{5}$
11. $13\frac{5}{6} - 7\frac{3}{4}$
12. $2\frac{1}{2} \div 5$
13. $8\frac{1}{6} + 4\frac{1}{6} + 3\frac{3}{5}$
14. $6 \times 3\frac{3}{8} \times 2\frac{4}{5}$
15. $3\frac{1}{8} \div 1\frac{1}{4}$

PRACTICE TEST IN DECIMALS IV (8 minutes)

1. .8 + .8 + .9
2. 7 × .4
3. .463 − .358
4. 7.84 ÷ 4
5. 6 × .009
6. .1498 ÷ 7
7. .16 + .34 + .27
8. .4 × .07
9. 18.13 ÷ .7
10. 5.11 + 24 + .7
11. .32 × 2.14
12. .7 − .652
13. 1.44 ÷ .12
14. 4.352 − 4
15. 100 × .438
16. 11.25 ÷ 2.25

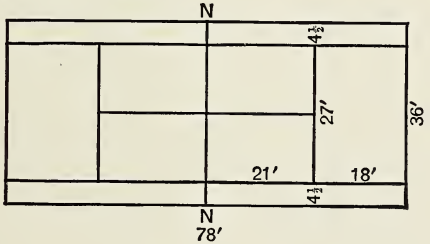
PRACTICE TEST IN PER CENT IV (8 minutes)

1. 1.625 = —%
2. 2.5 = —%
3. 6.5% = ? decimal
4. $\frac{1}{20}$ = —%
5. 5% of 800 =
6. 2 = —% of 40
7. 120% of 60 =
8. 4 = 2% of —
9. 108 = —% of 54
10. 45% of 200 =
11. 35 = —% of 500
12. 27 = 9% of —
13. $33\frac{1}{3}$% of 270 =
14. 40% of — = 64
15. 18 = —% of 9,000
16. 75 = 5 % of —

SECTION VI

DRAWING TO SCALE

Fred and Harry wish to lay out a tennis court. Below is the plan of the tennis court that they drew to the scale of $\frac{1}{4}$ inch to 4 feet.



1. What are the dimensions of the tennis court?

2. If $\frac{1}{8}$ inch represents 4 feet, how long a line represents 36 feet, the width of the court?

Think: $36 \div 4 = 9$, the number of $\frac{1}{8}$ inches that expresses the width of the court.

3. How long a line represents the length of the court?

4. Make a drawing of a tennis court, using a scale of $\frac{1}{2}$ inch to 4 feet. Will the plan be larger or smaller than the one above?

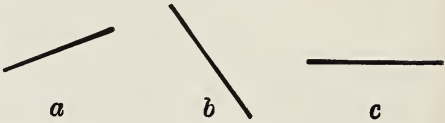
5. Supply the numbers missing in the following, using a scale of $\frac{1}{2}$ inch to 5 feet:

Original length	20 ft.	30 ft.	40 ft.	....	92 ft.	....	143 ft.
Scale length...	2 in.	....	....	6 in.	....	$10\frac{1}{2}$ in.	....

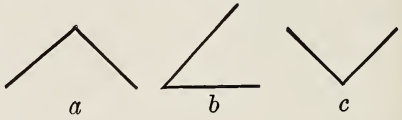
CONSTRUCTION PROBLEMS

1. Draw lines in positions *a*, *b*, *c*, and construct perpendiculars to each.

2. Bisect lines in the positions *a*, *b*, *c*.



3. Bisect angles in the positions *a*, *b*, *c*.



4. Draw a horizontal line AB. Mark off two points C and D 2 inches apart. At C construct an angle of 40° and at D an angle of 50°. Are the sides of the angles parallel?

5. Draw a perpendicular to a slanting line. How do you know that these lines are perpendicular to each other?

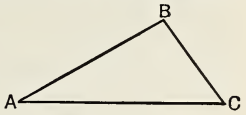
6. Draw a line AB of convenient length and mark two points C and D. At C draw a line CX which makes an angle of 30° with AB. At D draw a line DY which makes an angle of 30° with AB. Would CX and DY ever meet if extended? Are CX and DY parallel or perpendicular to each other?

7. Draw a pair of lines that make angles of 50 degrees with a given line. Draw one of the pair above the line and one below the line. Are the two lines parallel?

8. Construct lines that are perpendicular to the same line. Are they parallel or perpendicular to each other?

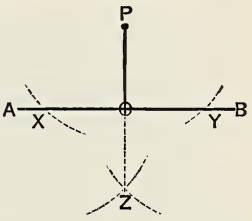
9. Construct two lines, one above and one below another line, that are perpendicular to that line. Are the two lines parallel or perpendicular to each other?

HOW TO CONSTRUCT THE ALTITUDE OF A TRIANGLE



Altitudes may be constructed quite accurately with compasses and ruler. To construct the altitude of the triangle ABC, you must learn to drop a perpendicular from B to AC.

To drop a perpendicular to a line from a point not on the line, using compasses and ruler, proceed as follows:



Let AB be the given line and P the given point without the line.

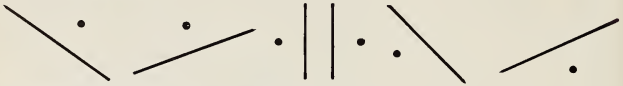
Place the sharp point of the compasses at P and the pencil point at any point below the line AB. Draw an arc cutting AB in two places, X and Y. Place the sharp point of compasses at X and draw an arc that will extend about as far below AB as P is above. Then place the sharp point of the compasses at Y and, using the same radius, draw an arc intersecting the first arc. Label the intersection of the two arcs Z.

Lay your ruler on the points P and Z and draw a line from P to AB. This line is the desired perpendicular. Prove this by measuring the angles at O.

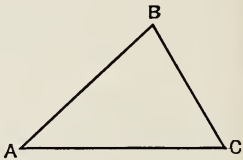
1. Draw a line XY on your paper and construct a perpendicular to it from a point above the line, using the method outlined above. Practise constructing perpendiculars to lines until you are sure that you understand the method. Also practise constructing perpendiculars to lines on the blackboard.

2. Using the method explained in problem **1**, construct a perpendicular to the line from a point below the line.

3. Construct a perpendicular either on your paper or on the blackboard for each of the following positions of point and line:



4. Construct the altitude of triangle ABC. Here you must drop a perpendicular from B to AC.



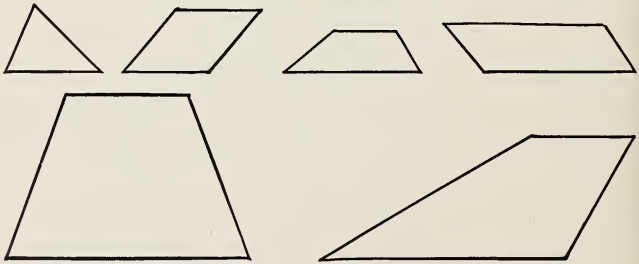
Use the method described above to construct the altitude.

5. Construct a triangle the sides of which are 2, 2, and 3 inches. Construct the altitude of the triangle.

6. Construct an equilateral triangle each side of which is 3 inches. Construct the altitude of the triangle. Use your ruler to measure the altitude. Then find the area of the triangle.

7. Construct two isosceles triangles having the same bases and sides. Draw the altitudes of the two triangles, using a different method for each triangle.

*8. Construct altitudes of figures having the following shapes, using as many different methods as you can.



CONSTRUCTING TRIANGLES AND MEASURING THE ANGLES

1. Construct a triangle with sides $1\frac{1}{4}$ inches, $1\frac{1}{2}$ inches, and $1\frac{3}{4}$ inches. What kind of triangle is this?

2. Construct a triangle with each side $1\frac{1}{2}$ inches long. What kind of triangle is this?

3. Construct a triangle each side of which is $1\frac{1}{4}$ inches long. What kind of triangle is this? Measure the angles with your protractor. How do the angles of the triangle compare in size?

4. A triangle whose angles are all equal is called an —— triangle. Is an equiangular triangle equilateral?

5. Construct a triangle having one side equal to 2 inches and two sides each equal to $1\frac{1}{2}$ inches. What kind of triangle is this? Point out two equal angles in this triangle.

6. Measure the angles of the triangle you constructed in problem **5**. How do the angles opposite the two equal sides of the triangle compare in size? Try this same experiment with other isosceles triangles. What do you conclude about the size of the angles opposite the two equal sides of an isosceles triangle?

7. Construct a triangle having sides of 3 inches, 4 inches, and 5 inches. What kind of triangle does it seem to be? Measure the largest angle to find whether or not you were correct. What other name is given to a triangle with sides all unequal?

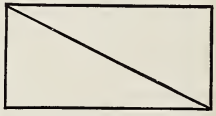
8. Construct a scalene triangle of convenient size. Measure the three angles with a protractor. How do they compare in size? Compare your findings with those of other members of the class. What do you conclude about the angles of scalene triangles?

COMPARING THE SIZES AND SHAPES OF TRIANGLES

1. Cut a square of convenient size from a sheet of paper. Make a fold from one corner to the opposite corner. Into what kind of triangles is the square divided by the fold in the paper? The line made by the fold is called the *diagonal* of the square.

2. Cut the square along the line of the fold. Fit the two parts of the square together. Do the two parts fit each other exactly? What part of the square is each of the triangles?

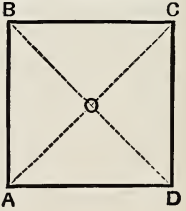
3. Measure each of the angles in one of the triangles. How do the acute angles compare in size? What kind of triangle is formed?



4. Draw on paper a rectangle that is not a square and cut it out. Fold on one diagonal. How do the triangles compare? What part of the rectangle is each triangle? What kind of triangle is each?

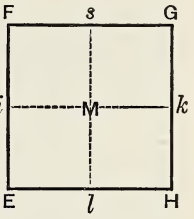
5. Measure the angles in each triangle in problem **4.** How do they compare in size?

6. Cut a square from a sheet of paper. Fold carefully along one diagonal. Then open the square and fold again along the other diagonal. How many triangles are thus formed? What kinds of triangles are formed? How do they compare in size? in shape?



7. Draw two squares equal in size on paper and cut them out. Fold one carefully on the diagonals, forming four triangles, as in *ABCD*. Fold

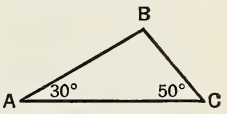
the other square *twice*, so that the opposite edges are together and thus form four small squares, as in *EFGH; i* and *k* are called the *midpoints* of *EF* and *GH*. What are the midpoints of *FG* and *EH?* How does each of the triangles compare in area with each of the small squares?



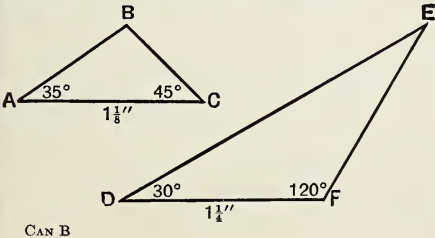
Making Copies of Triangles

This exercise describes different methods of making exact copies of triangles.

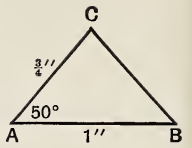
1. Construct a copy of triangle *ABC*, in which the length of *AC* and the size of the two adjoining angles are given. First draw *AC*. Then at *A* construct with a protractor an angle equal to 30°, and at *C* an angle equal to 50°. *Extend* the sides of the angles until they meet at *B*. *B* is called the *point of intersection* of these two lines. Cut out the triangle you have just drawn and place it over *ABC*. Does it fit exactly?



2. Use the method described in problem 1 to make copies of the following triangles:

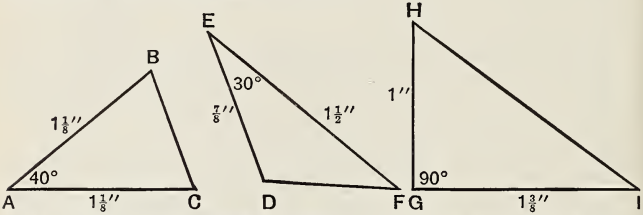


3. Construct a triangle equal to triangle ABC, in which two sides and the included angle A are given.



First draw a line segment equal to AB. Label it AB. At A construct an angle of 50°. Lay off the length AC. Label the end of the segment C. Connect B and C, thus forming triangle ABC. Cut out triangle ABC and match it with the triangle at the right. Do they match exactly?

4. Use the method described in problem **3** to make copies of the following triangles:



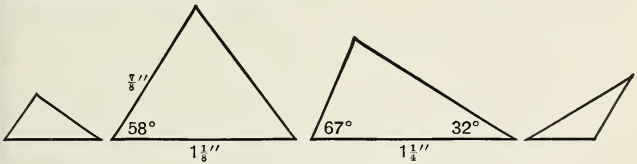
5. Margaret wished to draw a plan of the school garden, which was shaped like a triangle, to the scale of 1 inch to 10 feet. She found that the lengths of the three sides of the garden were 20′, 15′, and 25′.

She thought, "If the scale is 1″ to 10′, the lengths of the sides of my plan will be 2″, $1\frac{1}{2}''$, and $2\frac{1}{2}''$." Was Margaret correct?

She drew a line 2 inches long and labelled the ends A and B. Using A as a centre and with a radius equal to $2\frac{1}{2}''$, she made an arc. Then with B as a centre and with a radius equal to $1\frac{1}{2}''$, she made an arc cutting the first arc at C. Then she drew AC and BC.

6. Make a drawing of the triangle Margaret drew, using the method described above.

7. Make copies of the following triangles. Cut out your triangles and see if they exactly match the corresponding triangles below.



When Triangles Are Congruent

The following exercises will explain several methods of showing that two triangles are equal:

1. Construct a triangle ABC in which AB is $1\frac{1}{2}$ inches long, BC, 2 inches, and angle B, 40°. Construct a triangle DEF in which DE is $1\frac{1}{2}$ inches long, EF, 2 inches, and angle E, 40°. Are these triangles of the same size and shape? Cut them out and see if they fit exactly.

Two triangles that have exactly the same shape and size are said to be congruent (*pronounced* kŏng′grōō-ĕnt).

2. Construct a triangle ABC in which AC is 2 inches long, BC, 3 inches, and angle C, 100°. Construct a triangle DEF in which DF is 2 inches long, EF, 3 inches, and angle F, 100°. Are these triangles congruent? Why?

Two triangles are congruent if two sides and the included angle of one are equal respectively to two sides and the included angle of the other.

3. Construct a triangle ABC in which AB is 3 inches long, angle A, 30°, and angle B, 40°. Construct a triangle DEF in which DE is 3 inches long, angle D, 30°,

and angle E, 40°. Are the triangles of the same size and shape? Cut them out of paper and see if they will fit exactly.

4. Try this with triangles of various shapes to determine whether or not the above statement is always true.

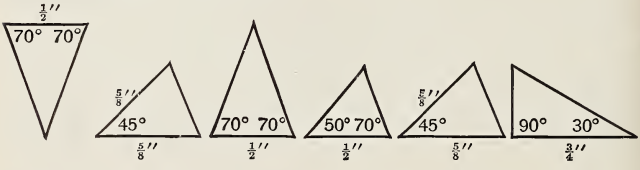
Two triangles are congruent if one side and the two adjacent angles of one are equal respectively to a side and the two adjacent angles of the other.

5. Construct a triangle BCD in which BC is 2 inches long, CD, $1\frac{1}{2}$ inches, and BD, $1\frac{1}{4}$ inches. Construct a triangle DEF in which DE is 2 inches long, EF, $1\frac{1}{2}$ inches, and DF, $1\frac{1}{4}$ inches. Are the two triangles congruent?

Make a statement concerning any two triangles which have three sides of one equal to three sides of the other.

6. State three conditions under which triangles are congruent.

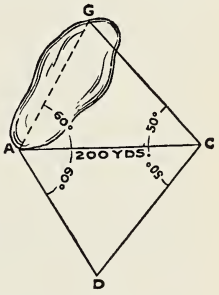
7. Select pairs of triangles from those given below that are congruent. Tell why.



8. Construct two triangles containing angles of 30°, 70°, and 80°. The base of one of these triangles should be longer than that of the other. Are these two triangles congruent? State your reasons. Make a statement regarding two triangles which have the angles of one equal to the corresponding angles of the other.

*MEASURING DISTANCES WITH EQUAL TRIANGLES

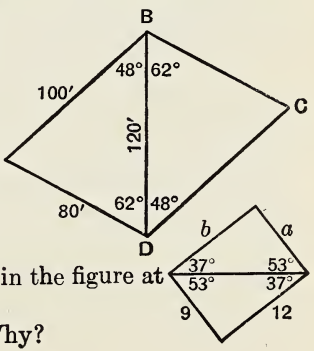
Two boy scouts wished to know how far it was from their camp at A to the big tree at G on the opposite side of the lake. They used the following method to find the distance:



They measured off 200 yards from A to C. Then they measured the angle GAC with a field protractor and found it to be 60°. On the opposite side of AC they constructed an angle of 60°. In the same manner they measured the angle ACG, found it to be 50°, and constructed an angle of 50° on the opposite side of AC. Finally they walked along the sides of these angles until they met at the tree D.

1. Name the two triangles the boys formed. Show that they are congruent; that is, that they have exactly the same size and shape.

2. Which line in the triangle ADC *corresponds* to AG? How can the boys find the distance from A to G across the lake?



3. How long is BD in the figure at the right?

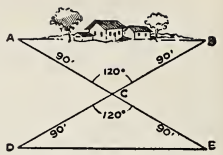
4. How long is side BC? Why?

5. How long is side CD? Why?

6. What is the length of a in the figure at the right? Why?

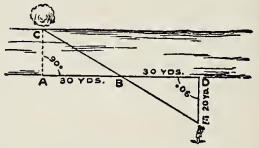
7. How long is side b? Why?

8. Mr. Benson wished to find the distance from A to B in the figure at the right. He could not measure the distance directly, however, because of the farm buildings. How might he use the figure to find the length of AB?



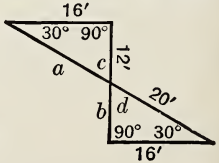
9. A scoutmaster showed some boy scouts how to find the distance across a stream by a figure like the one below at the right.

From a point A directly across from a tree at C he paced off 30 yards to B and drove a stake. Then he extended the line AB, 30 yards to D. Next he walked at a right angle to AD until he could sight B and C in a line with E. He measured DE. Then he drew the figure at the right.



a. What two triangles are there in the figure? Show that they are congruent.

b. What side of triangle BDE corresponds to AC? How can the boy scouts find the distance across the stream?



10. How long is a in the figure at the right?

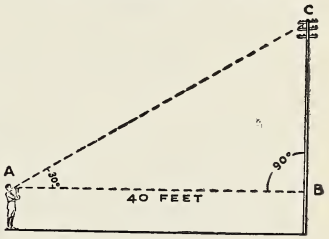
11. How long is b?

12. How many degrees are there in angle c? in angle d?

**13.* Make up a problem about measuring distances with the use of equal triangles. Exchange your problem for a problem written by one of your classmates. Solve his problem.

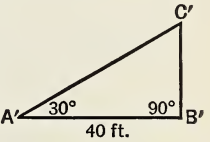
MEASURING HEIGHTS

Arthur and John devised a method of measuring the height of a telephone pole by measuring two angles and the included side of a triangle. This is how they did it.



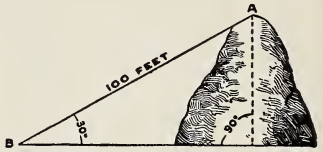
From the bottom of the telephone pole they measured off a distance of 40 feet. Standing at this point, Arthur measured with his field protractor the angle formed by the base of the protractor and a line extending from his eye to the top of the telephone pole.

1. How large is the angle at A?
2. Why is the angle at B equal to 90°?
3. How are the three sides of triangle ABC formed?
4. Next the boys made a drawing of triangle ABC to the scale of 1 inch to 40 feet. How long was the line representing the distance AB? Draw such a line and label it $A'B'$. Read $A'B'$ as *A prime B prime.*



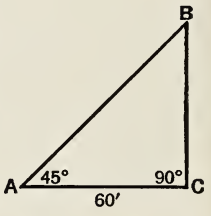
5. At A' they constructed an angle of 30° and at B' an angle of 90°. They extended the sides until they intersected at C', forming triangle $A'B'C'$. Then they measured $B'C'$. How long a line did $B'C'$ represent?
6. Assuming that Arthur's eye is 5 feet 4 inches above the ground, how high is the telephone pole?
7. How could Arthur measure the distance from his eye at A to the top of the telephone pole? How long a line is represented by $A'C'$?

8. Some Girl Guides wished to measure the height of an Indian mound near their school. With a tape they measured the distance from A to B and found it to be 100 feet. The angle at B was 30°. How high was the mound? Use a scale drawing.



9. Harold used the following method to measure the height of a telephone pole:

He walked away from the telephone pole along the line AC until he found that the angle at A was equal to 45°. Then he measured the distance from A to C and found it to be 60 feet.



a. Why is the angle at C equal to 90°?

b. How many degrees are there in the angle at B?

c. How long is BC? Remember that in any isosceles triangle the sides opposite equal angles are equal.

d. If the distance from Harold's eye to the ground is 5 feet, how high is the telephone pole?

***10.** Use one of the methods that have been described to find the height of some object.

***11.** Engineers measure the distance through a hill by making measurements such as those indicated on the drawing at the right. Find the distance through the hill, using the measurements given.

SOME INTERESTING CONSTRUCTION PROBLEMS

1. Construct two squares, one having sides of 1 inch and the other having sides of 2 inches. How do their areas compare?

2. Construct two squares, one having a perimeter of 8 inches and the other a perimeter of 4 inches. How do their areas compare?

3. Construct three rectangles of different dimensions, each having a perimeter of 12 inches. Compare their areas.

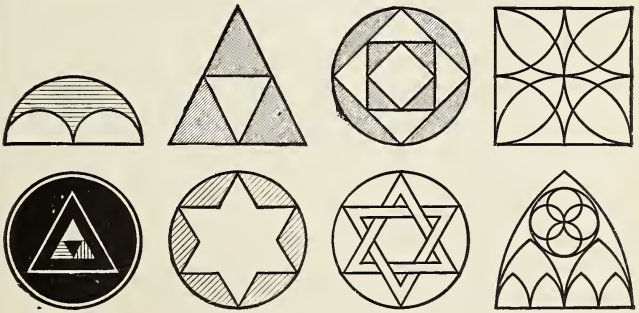
4. Construct two rectangles of different dimensions, each having an area of 12 square inches. How do their perimeters compare?

5. Construct two squares, one having sides twice as long as the other. What is the ratio of the areas of these squares?

6. How do the perimeters of the squares in problem **5** compare?

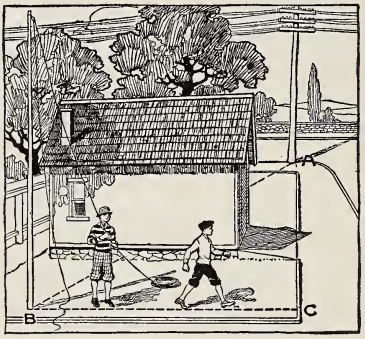
7. Construct a rectangle whose length is one and one-half times its width.

***8.** Make copies of the following designs:



USING SCALE DRAWINGS

Finding distances by scale drawings. Two boys wished to put up a radio aërial between the telephone pole at A and the pole at B. They could not measure the distance between the two poles because of the garage. Tom, who had completed a course in mechanical drawing, showed them how to find the distance by drawing to scale.



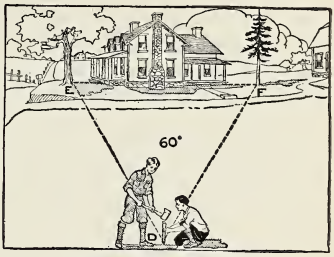
He told the boys to measure the distance from the corner of the lot at C to each of the poles. AC was 120 feet and BC was 90 feet, the directions of the measurements being at right angles to each other. Then Tom drew a plan of this to the scale of $1'' = 30'$. He then measured AB in the plan and found that it was 5 inches long. Since $1'' = 30'$, AB in the plan represented a length of 150 feet. The aërial should be 150 feet long.

Study the picture carefully until you understand Tom's solution of this problem.

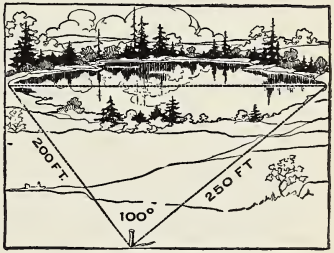
1. Make a drawing showing the sketch made by Tom.

2. To find the distance between two trees on opposite sides of a house, the boys set a stake at D (page 189). They measured DE and DF. DE was 60 feet long and DF was 60 feet long. With a field protractor they measured the angle at D, and found that it was 60°. They then con-

structed an angle of 60° on a sheet of paper. Using a scale of $1'' = 10'$, they laid off a line representing *DE* on one side of the angle, and another line representing *DF* on the other side of the angle. They then measured *EF*. How long was *EF*? What was the distance between the two trees?



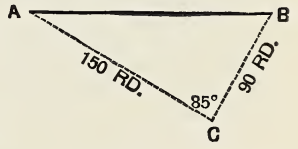
3. Find the distance across this pond. Use scale drawing.



4. Construct a 6-inch square. Find the length of a diagonal of the square.

5. Construct a rectangle 4 inches by 2 inches. Find the length of the diagonal.

6. Find the distance between *A* and *B*.

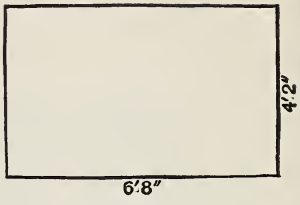


***7.** Use the method of drawing to scale to find the distance between two objects near your school where it is not convenient to measure the distance directly.

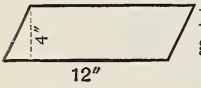
***8.** Make up a problem about using scale drawings. Draw a diagram to illustrate your problem. Solve the problem, or exchange it for a problem written by one of your classmates. If you exchange problems with a classmate, solve his problem.

FINDING AREAS

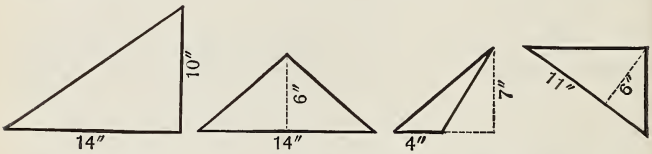
1. Use the formula, $A = bh$, to find the area of this rectangle.



2. Use the formula, $A = ba$, to find the area of this parallelogram.

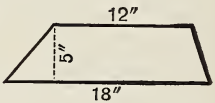


3. What is the base of each of the following triangles? the altitude?

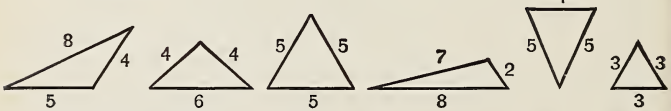


4. Use the formula $A = \frac{1}{2}\ ba$ to find the area of the triangles in problem **3.**

5. Use the rule, *Area = one half the height times the sum of the bases*, or the formula $A = \frac{1}{2}\ a\ (b + c)$ to find the area of this trapezium.



6. Which of the triangles below are scalene? isosceles? equilateral?



7. Draw scalene, isosceles, and equilateral triangles of convenient size on your paper, and then find the area of each.

8. What is the area of a square piece of ground 18 rods in length?

Find the areas of rectangles having the following dimensions:

9. $6\frac{1}{2}$ in. $\times$ 8 in.
10. 4 rd. by 1 rd.
11. $\frac{3}{4}$ mi. by $1\frac{1}{3}$ mi.
12. 3.5 yd. by 2.4 yd.
13. $7\frac{1}{2}'' \times 3\frac{2}{3}''$
14. .6 mi. $\times$ .8 mi.

Find the areas of triangles with these dimensions:

15. Base = 10 in., altitude = 12 in.
16. Base = 3.5 ft., altitude = 6.4 ft.
17. Base = $7\frac{1}{2}$ yd., altitude = 6 yd.
18. Base = .9 mi., altitude, 1.6 mi.

Find the areas of parallelograms with these dimensions:

19. Base = $4\frac{1}{2}$ in., altitude = $7\frac{1}{2}$ in.
20. Base = 7.5 in., altitude = 4.8 in.
21. Base = .6 ft., altitude = 1.4 ft.

22. Draw a rectangle 4 inches by 5 inches. Show by lines that it contains 20 square inches.

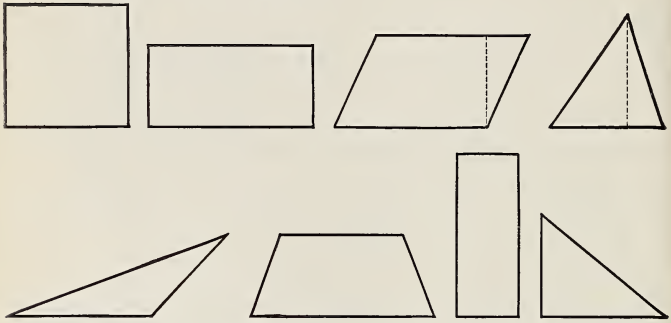
23. What unit of square measure would you use to express the area of each of the following? The floor of a room; the size of a province; the size of a farm; the page of a book.

***24.** Which has the greater area and how much, a rectangle whose length is 25 yards and width 30 feet, or a triangle whose base is 16 rods and altitude 20 feet?

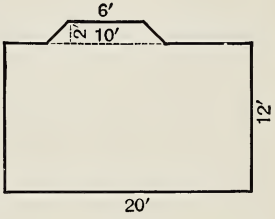
***25.** Draw to the scale, $\frac{1}{2}$ inch = 4 feet, a figure to represent a rectangle 40 feet long and 16 feet wide.

***26.** Draw to the scale, $\frac{1}{4}$ inch = 2 feet, a figure to represent a right triangle whose base is 12 feet and whose altitude is 10 feet.

***Finding areas from scale drawings.** **1.** The figures below are drawn to the scale, $\frac{1}{8}'' = 5'$. Find the areas which these figures represent.



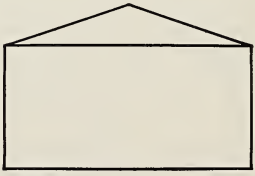
2. Find the area of the floor at the right.



3. Which has the larger area, a square 12 inches on a side or a rectangle 10 inches by 14 inches?

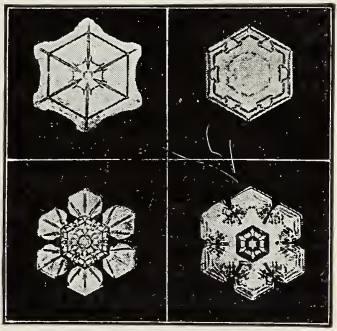
4. How many acres are there in a field 200 rods by 80 rods?

***5.** Measure the figure at the right and find its area. Pretend that the figure is drawn to scale and choose the scale. Find the area of the figure according to the scale which you have chosen.



***6.** Select a scale different from the one you used in problem **5** and find the area of the figure according to the scale.

THE REGULAR HEXAGON



Did you ever examine a single snowflake which had fallen on the sleeve of your coat? Nature has made some beautiful designs in these snowflakes by using geometrical figures. Examine these designs in the four snowflakes at the right.

1. In the picture of the snowflakes notice the snowflake at the right in the top row. Count the number of sides which this snowflake has. A six-sided figure is called a *hexagon.*

2. Measure the length of each of the sides of this snowflake. How do they compare in length? A hexagon having equal sides and equal angles is called a *regular* hexagon.

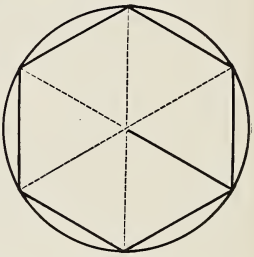
3. Examine the other crystals. If the points farthest from the centre were connected by straight lines, what shape would each crystal be?

4. Examine the first snowflake in the top row. How many angles are there at the centre? These angles are all equal. How many degrees are there in each central angle?

5. If one of the veins leading from the centre of the flake to one of the points were used as a radius and the centre of the snowflake as a centre, could a circle be drawn around the snowflake touching each of its six points? This is an example of a hexagon *inscribed* in a circle.

6. Measure the distance between two points of the snowflake in the top row at the left. How does the distance compare with the radius? Measure the distance between each of the other pairs of points. How does this distance compare with the radius?

How to Construct a Regular Hexagon



This figure contains a regular hexagon inscribed in a circle. How was it constructed? With your compasses measure very carefully the length of the radius of the circle. Compare this length with the length of the side of the hexagon. If you have measured carefully, you have found out this very important fact: *the side of a regular hexagon inscribed in a circle is equal to the radius of the circle.*

1. Construct a regular hexagon with each side 1 inch long. First draw a circle with a radius of 1 inch. Starting with any point in the circumference, lay off with your compasses distances equal to the radius. Then join the points.

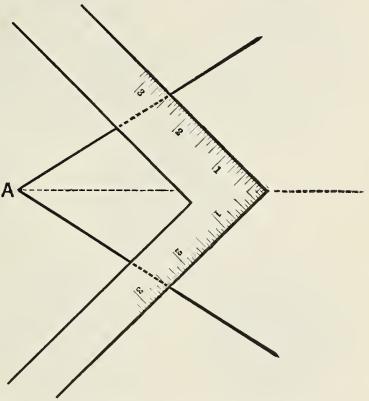
2. If all of the vertices of the hexagon are joined with the centre of the circle, how many triangles will be formed? How do the three sides of each triangle compare in length? What kind of triangles are they?

3. Practise drawing hexagons until you can do the work quickly and easily. Construct them of different sizes.

4. Try to draw a design similar to one of the snowflakes on page 193.

HOW THE CARPENTER BISECTS AN ANGLE

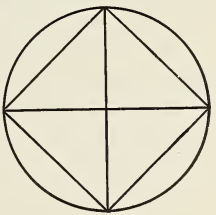
This drawing shows how a carpenter bisects an angle with his square. How is his method similar to that used in bisecting an angle with compasses? Perhaps you can secure a carpenter's square or construct one out of a piece of board and practise bisecting angles with it.



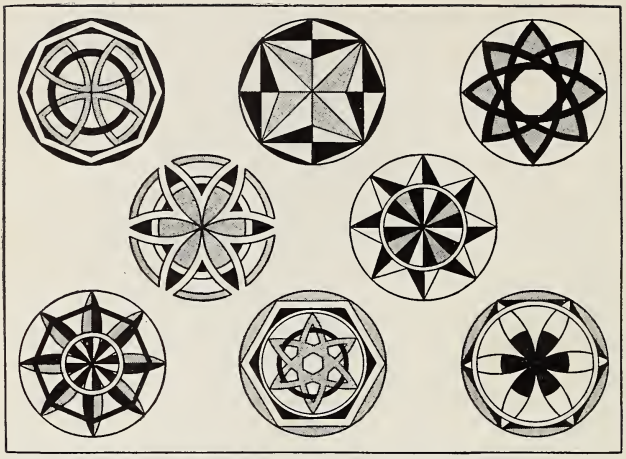
HOW TO INSCRIBE A SQUARE IN A CIRCLE

Many designs in cloth patterns and in architecture are based on the square inscribed in a circle and the circle inscribed in a square. To inscribe a square in a circle proceed as follows:

Draw a circle with a radius of $1\frac{1}{4}$ inches. Draw a diameter of the circle. Draw a second diameter perpendicular to the first one. In what ways can this be done? Connect the ends of the diameters in succession. Measure the four sides of the figure thus formed. Measure the angles at the vertices. Show that the figure is a square.



1. Draw a circle with a radius of $1\frac{3}{4}$ inches. Inscribe a square in the circle.

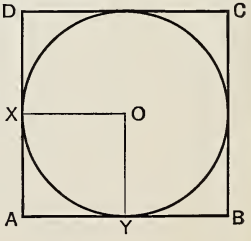


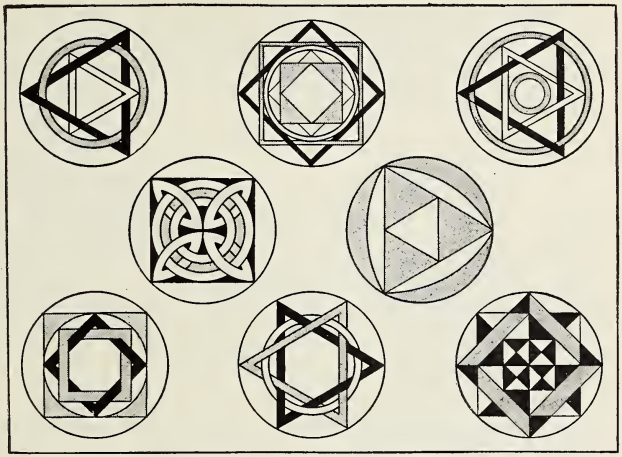
These designs and the designs on page 197 are based chiefly on inscribed or circumscribed triangles, squares, hexagons, octagons, and circles.

2. Inscribe a square in a circle with a diameter of $1\frac{1}{2}$ inches; with a radius of 1 inch; with a radius of 2 centimeters.

To inscribe a circle in a square, proceed as follows:

Draw a square, such as $ABCD$. Construct a perpendicular bisector to AB at Y, and another perpendicular bisector to AD at X. Extend these lines until they intersect at O. With O as a centre and OX as a radius, inscribe a circle in the square. If your work has been done carefully, the circle will just touch each of the sides of the square.

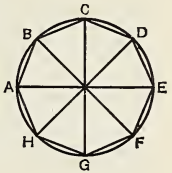




3. How do OX and OY compare? AX and AY? OX and AY? OX and AX?

4. Inscribe a circle in a $1\frac{1}{2}$-inch square; in a 2-inch square.

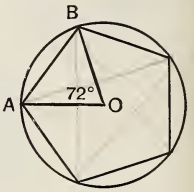
5. The figure at the right was formed by constructing four right angles at the centre of the circle and then bisecting them, thus forming eight equal angles. How many sides has the figure? Such an eight-sided figure is called a *regular octagon*. Construct a regular octagon in a circle with a radius of $1\frac{1}{2}$ inches.



6. The designs on pages 196 and 197 are based on inscribed and circumscribed squares, hexagons, octagons, and circles. Make a copy of at least two of the designs.

USING CENTRAL ANGLES TO CONSTRUCT POLYGONS

In the manual-arts class, Charles was asked to construct a regular pentagon; that is, a regular polygon of 5 sides. This is how Charles did it.



He drew a circle, marking the centre O.

He knew that the regular pentagon has five sides. Therefore it also has 5 equal central angles.

As the sum of the central angles is 360°, each central angle is $\frac{1}{5}$ of 360°, or 72°.

Using his protractor, Charles made an angle of 72° at O, the centre of the circle, and extended the sides of the angle to meet the circumference at A and B.

Charles then measured with his compasses the distance between A and B and laid off four other arcs on the circumference equal to AB. Joining the points he had a regular pentagon.

1. Following the method Charles used, draw a regular pentagon in a circle having a radius of two inches.

2. By joining each of the angles of a regular pentagon with each alternate angle, construct a five-pointed star.

3. How many degrees are there in each of the central angles of a regular octagon?

4. How many degrees are there in a central angle of a regular polygon of nine sides? of ten sides?

***5.** Draw a regular polygon of nine sides in a circle with a 2-inch radius. Draw a similar polygon in a circle with a 1-inch radius.

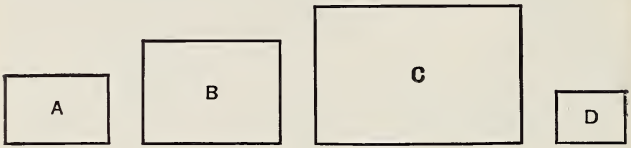
Are these two pictures identical or are they similar? If you decide that the figures are identical, give a reason for your decision. If you decide that the figures are similar, tell why they are similar.

USING SIMILAR FIGURES

Whenever you draw a map or a plan to scale, as you did in the preceding work, you draw a figure *similar* to the original in shape but different in size. When we reduce the size of a photograph, the smaller picture is similar to the larger one. Tell what has been done with the two pictures at the top of this page. In this section you are to learn some of the important uses of *similar* figures—that is, figures which are the same in shape but different in size.

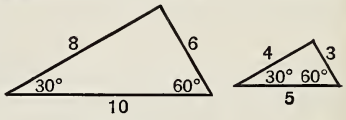
IMPORTANT FACTS ABOUT SIMILAR FIGURES

1. Which of the following rectangles seem to have the same shape; that is, are similar?



2. Name two of the above rectangles that are not similar in shape or size.

3. Why are the two triangles below similar? How can you tell that they have the same shape? Draw a triangle similar to them having a base of 1 inch.



4. What is the ratio of the sides opposite the two angles of 30°? The sides opposite the equal angles of similar triangles are called *corresponding* sides of the triangles.

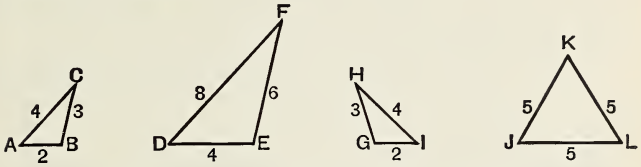
5. What is the ratio of the two sides opposite the angles of 60°? You can see that the two ratios found in problems **4** and **5** are equal; that is, $\frac{8}{4} = \frac{6}{3}$. An expression consisting of two equal ratios is called a *proportion.*

6. What is the ratio of the bases of the triangles in problem **3**? You can see that the ratios of the corresponding sides of similar triangles are all equal. In mathematics we say that the corresponding sides of similar figures have equal ratios and are always *proportional.*

7. On your paper draw two similar triangles of different sizes. Measure their sides with your ruler and show that the corresponding sides are proportional.

SIMILAR TRIANGLES

The first pair of triangles below is similar; the other pair is not similar.



1. AB and DE are a pair of corresponding sides in the two similar triangles. Why? Name two other pairs of corresponding sides in these two triangles.

2. The ratio of AC and DF is $\frac{4}{8}$ or $\frac{1}{2}$. What is the ratio of AB and DE? BC and EF? How do the three ratios compare?

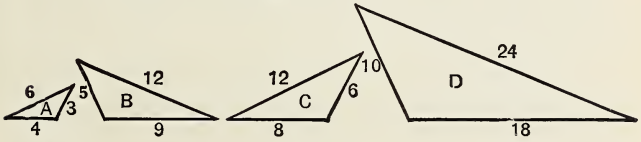
3. Does $\frac{AC}{DF}$ or $\frac{4}{8}$ equal $\frac{AB}{DE}$?

4. Show that $\frac{DF}{AC} = \frac{EF}{BC}$.

5. Show that the ratios of the sides of triangles GHI and JKL are not equal.

In similar triangles *the ratio of any pair of corresponding sides equals the ratio of either of the other pairs; that is, they are proportional.*

6. Which of the triangles below is similar to A? to B?



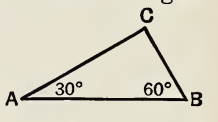
Show that the corresponding sides in each pair of triangles have the same ratio.

7. Measure the corresponding angles in the pairs of similar triangles. How do corresponding angles in similar triangles compare?

8. Draw two triangles of different sizes whose sides are in the ratio of 2 to 1. How do the angles in these triangles compare?

In similar triangles the corresponding angles are equal.

9. Draw a line segment, AB, of a convenient length. At A construct with a protractor an angle of 30°. At B construct an angle of 60° and extend the sides of the two angles so that they form a triangle. Call the point where the lines intersect C. Your drawing will look like the figure above.



a. Compare the shape of the triangle ABC with the shapes of the triangles drawn by your classmates. Do all the triangles that have been drawn have the same shape? Cut out these triangles and arrange them in a pile in the order of their size, placing the largest triangle at the bottom.

b. If the smaller triangles were enlarged without changing their shape, would they fit exactly upon the larger ones?

c. Why are all of these triangles similar?

Need all the triangles drawn by the pupils of the class be of the same size?

You see that if two angles of one triangle are equal to two angles of another triangle, the triangles have the same shape and are, therefore, similar.

USING ALGEBRA TO FIND MISSING NUMBERS IN PROPORTIONS

In any proportion it is easy to find missing numbers by using algebra.

1. Find the missing number represented by x in the following proportion:

$$\frac{x}{5} = \frac{16}{20}$$

Multiply both sides by 5, $5 \times \frac{x}{5} = 5 \times \frac{16}{20}$

Cancelling, $x = 4$

Check, by writing 4 for x in the proportion, $\frac{x}{5} = \frac{16}{20}$

$$\frac{4}{5} = \frac{16}{20}$$

This proportion may also be written in another way:

$$\frac{16}{20} = \frac{x}{5}$$

Multiply both sides by 5, $5 \times \frac{16}{20} = 5 \times \frac{x}{5}$

Cancelling, $4 = x$

Check, $\frac{16}{20} = \frac{4}{5}$

Find and check the value of x:

2. $\frac{x}{6} = \frac{12}{18}$ **6.** $\frac{30}{6} = \frac{x}{4}$ **10.** $\frac{75}{90} = \frac{x}{10}$

3. $\frac{x}{12} = \frac{6}{24}$ **7.** $\frac{7}{12} = \frac{x}{60}$ **11.** $\frac{54}{12} = \frac{x}{36}$

4. $\frac{x}{15} = \frac{200}{150}$ **8.** $\frac{90}{20} = \frac{x}{10}$ **12.** $\frac{x}{1{,}000} = \frac{96}{200}$

5. $\frac{x}{75} = \frac{150}{225}$ **9.** $\frac{x}{8} = \frac{49}{56}$ **13.** $\frac{x}{55} = \frac{9}{3}$

14. How many miles does a train travel in 6 hours at the rate of 55 miles in 2 hours?

Solution: Let x represent the number of miles travelled in 6 hours.

Form the proportion, $\frac{x}{55} = \frac{6}{2}$

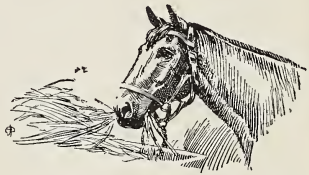
Multiplying by 55, $55 \times \frac{x}{55} = 55 \times \frac{6}{2}$ Check, $\frac{165}{55} = \frac{6}{2}$

Cancelling, $x = 165$

Hence the train travels 165 miles in 6 hours.

15. If 6 horses eat 600 pounds of feed a week, how many pounds will 8 horses eat in the same time at the same rate?

16. If in one day 4 one-man tractors can plow a 30-acre field, how many such tractors are needed to plow a 60-acre field in one day working at the same rate?



17. If 4 bags of cement are needed to build a walk 40 feet long, how long a walk can be built with 16 bags of cement?

18. In a 50-mile automobile race the winner's time was 48 minutes. At that rate how far could he go in an hour?

19. A 6-pound roast cost Mrs. Nelson $2.40. At that rate how much would she pay for a 10-pound roast?

20. On a 30-acre field Mr. Morse raised 480 bushels of wheat. At that rate how many bushels of wheat will be raised on a 45-acre field?

21. Mr. Atkin raises 400 bushels of wheat on a 25-acre field. How many bushels could he raise, at that rate, on a 160-acre field?

22. Mr. Smith and Mr. Jones were partners in a business. Mr. Jones invested $5,000 in the business and Mr. Smith $7,500. The net profits for the first year were $1,250.

How much was each partner's share of the profits if they divided these profits in proportion to the amount each had invested in the business?

23. A fast passenger train travels 20 miles in 25 minutes. At that rate how long does it take the train to travel 75 miles?

24. Mr. Bertram paid \$75 for 250 dozen eggs. At the same rate how much would he pay for 180 dozen?

25. 4 is to 6 as 8 is to what number?

26. 5 is to 4 as 15 is to —.

27. 3 is to what number as 6 is to 12?

28. What number is to 10 as 5 is to 20?

29. The pupils of the mathematics class drew to scale the plan of a field 40 rods long and 25 rods wide. John's plan was 8 inches long. How wide was it?

30. A man receives \$5.40 for 9 hours' work. How much does he receive for 12 hours' work at the same rate?

31. An alloy of silver and copper weighing 54 ounces contains 42 ounces of silver. How much silver is there in 27 ounces of the alloy?

32. A recipe for making ice cream calls for 3 parts of cream to 4 parts of milk. In making the ice cream you wish to use 10 quarts of milk. How many quarts of cream should you use with this recipe?

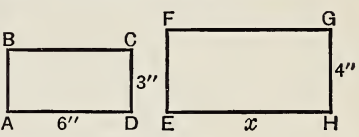
*__33.__ A passenger train travels 300 miles in 8 hours. At the same average rate an hour, how many miles can it travel in 12 hours?

*__34.__ A certain road rises 3 feet for every 160 feet of the slope. How many feet does the road rise in a distance of one mile? A diagram of this problem will help you.

USING SIMILAR FIGURES

The fact that the ratios of the corresponding sides of similar figures are equal can be used in many ways.

1. In the two similar rectangles at the right the length of the base of the larger is missing. Without measuring we can find its length by using an easy proportion.



We can form several proportions by using the sides of these two rectangles.

a. Complete the following proportions:

(1) $\frac{EH}{AD} = \frac{EF}{?}$ (2) $\frac{AD}{?} = \frac{AB}{?}$ (3) $\frac{EH}{EF} = \frac{?}{AB}$

b. Which proportion would you use to find x?

2. Using the proportion, $\frac{EH}{AD} = \frac{EF}{AB}$, find the value of EH by substituting the values given in the rectangles.

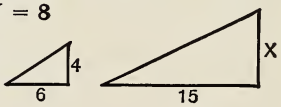
Let x = the number of inches in the length of EH.

Substituting values for letters, $\frac{x}{6} = \frac{4}{3}$

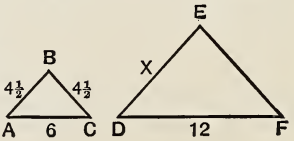
Multiply both sides by 6, $\frac{6x}{6} = \frac{6 \times 4}{3}$

Then, x or $EH = 8$

3. What is the length of the side X in the triangle at the right?

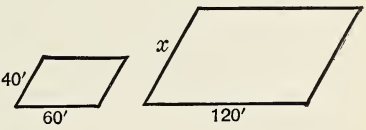


4. Mr. James wishes to make a triangular flower bed similar to a small one he has in his front yard, the sides of which are 6 feet, $4\frac{1}{2}$ feet,



and $4\frac{1}{2}$ feet. He wishes the longest side to be 12 feet. How long must the sides DE and EF be?

5. Two small gardens shaped like the parallelograms at the right are similar. Find the length of the side marked x.



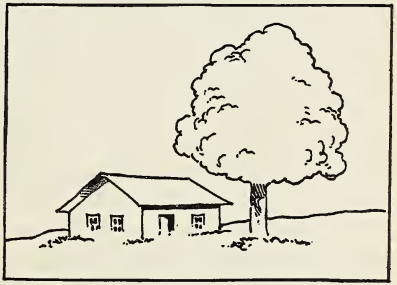
Find the value of x in the following proportions:

6. $\frac{x}{4} = \frac{1}{2}$ **8.** $\frac{5}{6} = \frac{x}{12}$ **10.** $\frac{7}{8} = \frac{x}{24}$ **12.** $\frac{7}{12} = \frac{x}{36}$

7. $\frac{x}{9} = \frac{3}{27}$ **9.** $\frac{2}{5} = \frac{x}{20}$ **11.** $\frac{x}{5} = \frac{9}{15}$ **13.** $\frac{x}{6} = \frac{3}{4}$

14. A photographer wishes to enlarge a picture $7\frac{1}{2}$ inches long and 6 inches wide, so that it will be 15 inches long. How wide will the enlargement be?

15. Jack wishes to reduce the size of a picture 5 inches long by 4 inches wide so that it will be 2 inches wide. How long will the smaller picture be?

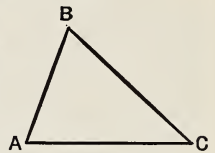


These are similar figures. Why?

In examples **16** to **18**, make a proportion to find the lengths of the unknown sides. Use compasses to construct the triangles. Use the triangle on page 208 to locate the position of the sides.

16. Construct a triangle with AB equal to 2 inches, BC equal to 3 inches, and AC equal to 4 inches. Construct a triangle similar to it with AB equal to 1 inch.

17. Construct a triangle with AB equal to 2 inches, BC equal to $2\frac{1}{2}$ inches, and AC equal to 3 inches. Construct a triangle similar to it with AC equal to 4 inches.



18. Construct a triangle with AB equal to 2 inches, AC equal to $1\frac{3}{4}$ inches, and BC equal to $2\frac{1}{2}$ inches. Construct a triangle similar to it with AB equal to 4 inches.

19. Construct a triangle with sides 2 inches, 4 inches, and 5 inches. Construct a triangle similar to it with side 3 inches to correspond to the given side 2 inches.

20. The sides of a triangle are 7 inches, 9 inches, and 11 inches respectively. Find the sides of a similar triangle if its shortest side is 12 inches.

21. Construct a triangle having sides 4 inches, 3 inches, and 2 inches. Construct a second triangle having sides half as long as those in the first. Are the triangles similar?

22. Construct an equilateral triangle having each side 3 inches long. Construct another equilateral triangle having each side 2 inches long. Are the triangles similar?

***23.** A map is 9 inches long and 6 inches wide. If it is enlarged to 18 inches wide, how long will it be? to 12 inches wide? to 15 inches wide?

***24.** Make up a problem about enlarging a photograph.

***25.** Make up a problem which requires the use of similar figures. Construct the figures. Solve your problem or exchange with another pupil in the class. If you exchange, solve your classmate's problem.

HOW TO USE SHADOWS IN MEASURING HEIGHTS

1. Tom and Jack wished to find the height of a tree. Jack held an 8-foot rod in a vertical position, and Tom measured its shadow and found it to be 12 feet long. The boys then measured the shadow of the tree and found it to be 45 feet long. What was the height of the tree?

Let x = number of feet in the height of the tree.

Since the ratio of the height of the rod and of the tree equals the ratio of the length of their shadows, we may write an easy proportion.

Write the proportion: $\frac{x}{8} = \frac{45}{12}$

Solving for x, $x = 30$

The tree is 30 feet high.

2. A school building cast a shadow 56 feet long. At the same time a 12-foot stick held vertically cast a shadow 16 feet long. What was the height of the school?

3. A flagpole cast a shadow 280 feet long. A stick 6 feet high cast a shadow 9 feet long at the same time. What was the height of the flagpole?

4. When a telegraph pole casts a shadow 50 feet long, Arthur, who is 6 feet tall, casts a shadow 4 feet long. How high is the pole?

5. If a 6-foot rod casts a shadow 1 foot long, tell the height of a tree whose shadow is 5 feet long at the same time.

*6. A tree casts a shadow 28 feet long when a post 5 feet high casts a shadow 4 feet long. Find the height of the tree. Make a drawing to scale to show the heights of the tree and the post and the lengths of their shadows.

REVIEW OF IMPORTANT POINTS

1. When are two figures similar?

2. What do we mean when we say that the shape of some objects are out of proportion?

3. Is this pair of ratios correct? $\frac{4}{5} = \frac{16}{20}$

4. Find the value of x in the following equations:

a. $\frac{x}{4} = \frac{3}{4}$ *d.* $x + 4 = 18$ *g.* $\frac{3x}{5} = \frac{9}{10}$

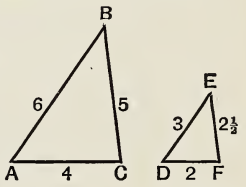
b. $5x = 40$ *e.* $3x - 7 = 23$ *h.* $2x + 6 = 14$

c. $\frac{x}{10} = \frac{4}{5}$ *f.* $\frac{x}{7} = \frac{16}{21}$ *i.* $\frac{x}{6} = \frac{3}{2}$

5. Find the value of x: *a.* $\frac{x}{8} = \frac{3}{8}$ *b.* $\frac{x}{12} = \frac{5}{3}$

6. If Harry earns \$4.00 in 10 hours, in how many hours does he earn \$2.80? Solve by means of a proportion.

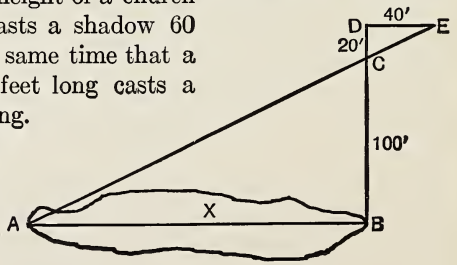
7. Show that triangles *ABC* and *DEF* are similar.



8. Construct two similar triangles having base angles of 40° and 60°. Show that the corresponding sides are proportional.

9. Find the height of a church steeple which casts a shadow 60 feet long at the same time that a vertical rod 10 feet long casts a shadow 6 feet long.

10. Find the distance from *A* to *B* by using similar triangles.



PRACTICE TESTS

Practise the examples in each set until you can work all of them correctly in the time allowed. Keep a record of your daily scores. Try to better the record you made on previous practice tests.

PRACTICE TEST IN FRACTIONS V (8 minutes)

1. $\frac{7}{12} + \frac{3}{4}$
2. $7\frac{5}{8} - 2\frac{3}{8}$
3. $19 \times 24\frac{1}{2}$
4. $7 \div \frac{2}{3}$
5. $94\frac{1}{6} - 12\frac{5}{6}$
6. $3\frac{2}{3} \times 8$
7. $\frac{1}{4} \div \frac{1}{3}$
8. $\frac{3}{4} + \frac{1}{4}$
9. $1\frac{1}{4} \div \frac{1}{4}$
10. $\frac{2}{5} \times 3\frac{2}{3}$
11. $4\frac{2}{5} \div 2$
12. $7\frac{3}{10} + \frac{5}{8} + 8$
13. $5\frac{3}{8} \times 6 \times 2\frac{1}{3}$
14. $4\frac{5}{6} - \frac{3}{8}$
15. $6\frac{2}{3} \div 1\frac{3}{4}$

PRACTICE TEST IN DECIMALS V (8 minutes)

1. .06 + .04 + .03
2. .8 − .8
3. .2 × .4
4. 8.5 ÷ 5
5. .48 + .53 + .69
6. 5.4 × 3.2
7. .9 − .43
8. .852 ÷ 3
9. 7 × 5.64
10. 8.1 ÷ .3
11. 4.25 + 7 + 9.755
12. 1.2 × 63
13. 1.594 − .97
14. 3 ÷ .4
15. 10 × 76.2
16. 90 ÷ 1.8

PRACTICE TEST IN PER CENT V (8 minutes)

1. .04 = —%
2. 25% = ? decimal
3. .5 = —%
4. $\frac{1}{10}$ = —%
5. 8% of \$125 =
6. 20 = —% of 80
7. 18 = 6% of ——
8. 200% of 75 =
9. 20% of —— = \$.50
10. 18 = —% of 900
11. 40% of 76 =
12. $62\frac{1}{2}$% of \$4.00 =
13. 15% of —— = \$4.50
14. 90 = —% of 80
15. 65 = —% of 65
16. 7.28 = 6% of ——

CUMULATIVE TEST VI

You should be able to work all of these examples in less than *fifteen minutes.*

1. 968 (*3*)
883
524
896
643
937
575
789

2. 89,750 (*3*)
$-29{,}984$

3. 738 (*3*)
$\times\ 68$

4. $95\overline{)78{,}755}$ (*3*)

5. Solve for x: $2x - 7 = 21$ (*157*)

6. $8\frac{1}{5}$ (*12*)
$7\frac{9}{10}$
$+4\frac{3}{10}$

7. $17\frac{7}{8}$ (*14*)
$-16\frac{3}{4}$

8. $8\frac{1}{4} \times \frac{1}{3} =$ (*17*)

9. $8 \div 12\frac{1}{2} =$ (*19*)

10. 101.70 (*25*)
$-\ 12.58$

11. 29.85 (*26*)
$\times\ 69$

12. $42.9\overline{)317.46}$ (*27*)

13. 12% of 76 = (*34*)

14. 15 = —% of 90 (*35*)

15. 150 = $12\frac{1}{2}$% of ? (*35*)

16. Express $\frac{15}{16}$ as a decimal and as a per cent. (*28*)

17. Add 1.75, .375, 46.2, and 9.378. (*25*)

18. Add 5 ft. 4 in., 6 ft. 7 in., and 10 in. (*28*)

19. 135 = —% of 60. (*35*)

Solve for x in the following:

20. $3x = 2\frac{1}{2}$ (*144*)

21. $x - 7 = 16$ (*151*)

22. $x + 3 = 5$ (*150*)

23. $\frac{x}{5} = \frac{12}{25}$ (*152*)

24. $2x - 7 = 9$ (*157*)

25. $\frac{x}{4} = 5$ (*152*)

VOCABULARY EXERCISE

Explain each of the following:

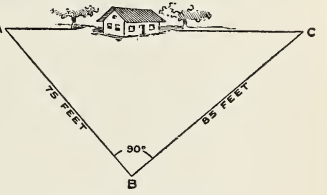
degree	centigrade	negative	protein
calorie	equation	velocity	boiling point
pyramid	formula	B. T. U.	altitude
cone	positive	Fahrenheit	candle power
sphere	metric	watt	area

REVIEW OF IMPORTANT POINTS

1. In a plan of a house to the scale of 1″ to 4′, how long a line represents 12′? 16′? 7′? 6′ 6″?

2. Give examples of the uses of drawing to scale.

3. Find by drawing to a convenient scale the distance from A to C in the figure at the right.

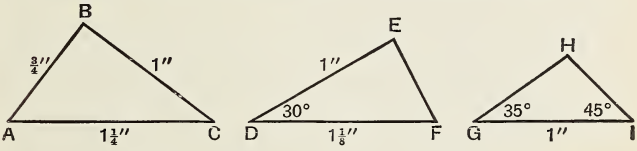


4. Explain the following formulas:

a. $A = \frac{1}{2}\,ba$ *c.* $A = ba$ *e.* $A = s^2$

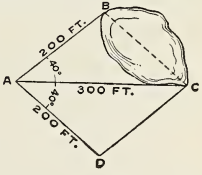
b. $A = \frac{1}{2}\,a(b + c)$ *d.* $A = lw$ *f.* $P = 2\,l + 2\,w$

5. Make a copy of each of the following triangles:



6. State three conditions under which two triangles are congruent.

7. Using the facts given in the figure at the right, find the distance BC across the lake.

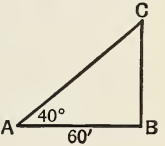


8. Solve for x in the following equations:

a. $x + 14 = 48$ *c.* $\dfrac{x}{4} = \dfrac{7}{8}$

b. $3\,x - 8 = 25$ *d.* $\dfrac{3\,x}{4} + 8 = 20$

9. Make a scale drawing to find the length of BC in the figure at the right.



PROBLEM SCALE IV

1. What is the cost of a dozen apples at 3 for 10¢?

2. The list price of a hat was $5.00. What was the net price, if the discount was 15%?

3. A real estate broker sold a house for Mr. Roper for $6,000. He forwarded Mr. Roper a bank draft for this amount less his commission of 2% and the cost of the draft, $2.00 What was the amount of the draft?

4. A swimming pool is 80 feet long and 60 feet wide. The average depth of the water in the pool is 5 feet. How long does it take to fill the pool if the water runs in at the rate of 100 cubic feet a minute?

5. A house, valued at $4,800, was insured for $\frac{5}{6}$ of its value. The rate was $\frac{1}{4}\%$ a year. What was the amount of the premium paid a year?

6. How many cubic feet of water will a rectangular tank 12 feet long, 4 feet 9 inches wide, and 2 feet 3 inches deep hold?

7. The actual valuation of a house is $8,250. The assessed valuation is $\frac{2}{3}$ of the actual valuation. If the taxes paid on the house are $165, what is the rate of taxation?

8. A retail dealer paid $3.00 a dozen for knives, after getting a discount of 25%. Find the list price of the knives a dozen.

9. A meter equals 39.37 inches. What fraction of a meter is a yard?

10. How many square yards of plaster will be needed for the walls and ceiling of a room 24′ by 18′ by 9′, making no allowance for openings?

SECTION VII

POWERS AND ROOTS

When a number is multiplied by itself, the product is called the *square* of the number, and the number is called the *square root* of the product. For example, 49 is the square of 7, and 7 is the square root of 49.

When we multiply a number by itself, we raise the number to the second *power*. We may write 7×7 as 7^2. This expression is read: 7 raised to the second power, or 7 squared. Thus 4^2 means 4×4. The *exponent*, ^{2}, means that 4 is used as a factor two times. 4^3 means $4 \times 4 \times 4$; $(\frac{1}{2})^2$ means $\frac{1}{2} \times \frac{1}{2}$.

1. Give the values of the following expressions:

5^2; 6^2; 2^3; 10^2; 15^4; $(\frac{1}{4})^2$; $(\frac{3}{4})^3$; $.5^2$; 1.5^3.

2. What are the squares of 4? 8? 3? 9?

$a \times a$ may be expressed as a^2; $r \times r \times r$ may be expressed as r^3.

3. Express the following, using exponents:

$b \times b$; $c \times c$; $r \times r$; $h \times h$; $s \times s \times s$.

4. We say that the formula for the area of a square is $A = s^2$. Explain the formula.

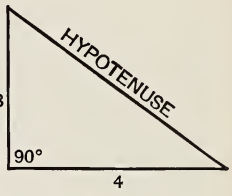
5. We say that the formula for the volume of a cube is $V = s^3$. Explain the formula.

In this section you will study more formulas in which are used letters, representing values, that are raised to the second and third powers.

FINDING THE LENGTH OF THE HYPOTENUSE

One of the most interesting topics in mathematics is the method of finding the length of the side opposite the right angle (the *hypotenuse*) of a right triangle when the other two sides are known.

Before this can be done, you must learn how to find the square root of a number.



1. What is the area of a square 6 inches on a side?

Think: $A = s^2$
$A = ?$

2. Mary and John have a garden whose area is 144 square yards. It is in the form of a square. What is the length of one side?

Think: $144 = s^2$.
What number multiplied by itself equals 144?
From your multiplication table you recall that 12×12 is 144.
The length of the side of the garden is 12 yd.

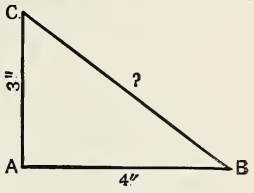
We say that 12 is the *square root* of 144 because $12 \times 12 = 144$. *The square root of a number is one of two equal factors of the number.* The square root of 36 is 6, because $6 \times 6 = 36$. The symbol $\sqrt{\ }$ means *square root.* $\sqrt{36}$ means the square root of 36.

3. Find the square root of 9; 16; 25; 36; 49; 64; 121.

4. A square tablecloth contains 64 square feet. What is the length of a side? Find $\sqrt{64}$.

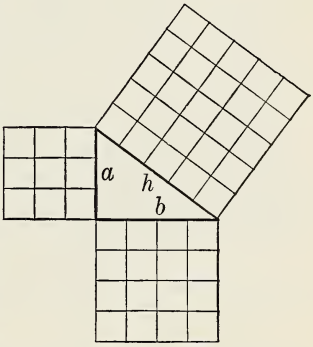
The Rule of Pythagoras. One of the important truths of mathematics is the rule of Pythagoras, a famous Greek mathematician. He proved this rule over 2,000

years ago. It is used to find the length of the side of a right triangle that is opposite the right angle. This side is called the *hypotenuse* of the triangle.



1. If AB is 4 inches long and AC is 3 inches long, what is the length of BC?

The length of BC may be found by construction as follows: Construct a right triangle like CAB with AB equal to 4 inches and AC equal to 3 inches. Measure the length of the hypotenuse carefully with a ruler. BC is —— inches long.



2. The rule of Pythagoras is this: *The square on the hypotenuse of any right triangle is equal to the sum of the squares on the other two sides.* This rule may be proved by studying the figure of the right triangle above.

A square is constructed on the hypotenuse. How many square inches are there in it?

$$h^2 = 25$$

How many square inches are there in each square on the other two sides?

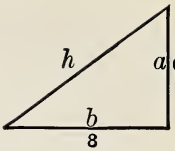
$$a^2 = 9 \qquad b^2 = 16$$

$$a^2 + b^2 = 25$$

Therefore $h^2 = a^2 + b^2$, since both equal 25 sq. in.

If h^2 equals 25, h equals the square root of 25, or 5.

3. Find h if $a = 6$ and $b = 8$.



Use the formula, $h^2 = a^2 + b^2$

$h^2 = 36 + 64$

$h^2 = 100$

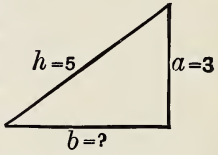
$h = \sqrt{100} = 10$

Find h when a and b are as follows:

4. $a = 9, b = 12$ **6.** $a = 15, b = 20$

5. $a = 12, b = 16$ **7.** $a = 18, b = 24$

The formula $h^2 = a^2 + b^2$ may also be used to find the length of either a or b when the length of the hypotenuse and of one of the other sides is known.



8. Find b if $h = 5$ and $a = 3$.

Begin with the formula, $h^2 = a^2 + b^2$

Substitute numbers for letters, $25 = 9 + b^2$

Subtract 9 from both sides, $25 - 9 = 9 - 9 + b^2$

Extract the square root of both members, $16 = b^2$

$4 = b$

Find a when h and b are as follows:

9. $h = 25, b = 15$ **11.** $h = 15, b = 9$

10. $h = 10, b = 6$ **12.** $h = 20, b = 12$

Find b when h and a are as follows:

13. $h = 5, a = 4$ **14.** $h = 30, a = 18$

Find the length of the missing side of right triangles with the following dimensions:

	a	b	h		a	b	h
15.	12	16	?	**19.**	3	?	5
16.	15	?	25	**20.**	?	8	10
17.	30	40	?	**21.**	?	24	30
18.	?	16	20	**22.**	24	32	?

FINDING SQUARE ROOTS FROM A TABLE OF SQUARES

Tables of squares are used by architects and engineers in working with squares of numbers. If you have a table of squares, you can find the approximate square root of any number.

PART OF A TABLE OF SQUARES OF NUMBERS

NUMBER	SQUARE	NUMBER	SQUARE	NUMBER	SQUARE
21	441	46	2116	77	5929
22	484	47	2209	78	6084
23	529	48	2304	79	6241
24	576	49	2401	80	6400
25	625	50	2500	81	6561

1. From the table it can be seen that 576 is the square of 24. What is the approximate square root of 600?

The square root of 600 must be between 24 and 25, since 600 is less than the square of 25, which is 625. Six hundred is about halfway between 576 and 625. Hence the square root of 600 must be about 24.5.

To find whether your estimate is correct, multiply 24.5 by 24.5; that is, square 24.5.

$$\begin{array}{r} 24.5 \\ \times\ 24.5 \\ \hline 12\,25 \\ 98\,0 \\ 490 \\ \hline 600.25 \end{array}$$

Since the product of 24.5 and 24.5 is approximately equal to 600, the approximate square root of 600 is 24.5.

Find the approximate square roots of these numbers, using the partial table of squares given above. Check each result by squaring the answer.

2. 555 **3.** 462 **4.** 490 **5.** 520 **6.** 630 **7.** 2,450 **8.** 2,175 **9.** 2,210 **10.** 6,100 **11.** 6,375 **12.** 6,261 **13.** 6,550

In the absence of a table of squares of numbers, we can find the approximate square root of any number using long division and averaging. The following is an example:

a. 1. To square any two-place number ending in 0.

$$40^2 = 4^2 \text{ affix } 00 = 1{,}600$$

2. To square any two-place number ending in 5.

$$35^2 = 3 \times 4 \text{ affix } 25 = 1{,}225$$

NOTE: Increase the tens digit by 1.

b. 1. Find the square root of 576.

$20^2 = 400$ and $25^2 = 625$, therefore the square root must be between 20 and 25. Try 22.

$$\begin{array}{r} 26 \\ 22\overline{)576} \\ 44 \\ \hline 136 \\ 132 \\ \hline \end{array}$$

$$\frac{22 + 26}{2} = \frac{48}{2} = 24$$

Neglect a small remainder.

Check: $24 \times 24 = 576$

2. Find the approximate square root of 957.

$30^2 = 900$, and $35^2 = 1{,}225$, therefore, the square root must be between 30 and 35. Try 31.

$$\begin{array}{r} 30.87 \\ 31\overline{)957} \\ 93 \\ \hline 270 \\ 248 \\ \hline 220 \\ 217 \\ \hline \end{array}$$

$$\frac{31 + 30.87}{2} = \frac{61.87}{2} = 30.93$$

Check: $30.93 \times 30.93 = 956.6649$

***Common method of computing square roots.** Some times it is not easy to find a square root by inspection. If a table of squares is not at hand, the following method may be used:

Find the square root of 1,849.

```
   4  3
 18 49
 16
83) 2 49
    2 49
```

a. Beginning at the right, separate the number into periods of two digits each. There are two periods; hence, there will be a two-place number as a square root if there is no remainder.

b. Find the largest square in the first period to the left. This is 16. Write 4, the square root of 16, in the quotient over the period. Write the square of 4, or 16, under 18.

c. Subtract 16 from 18, and bring down the number in the next period (49).

d. Begin the new division by taking twice the part of the root already found. ($40 \times 2 = 80$)

e. Divide 249 by 80. Write the result (3) as the second number of the quotient, and add it to the 80 to form the divisor 83.

f. Multiply 83 by the 3 in the quotient. Since there is no remainder, the work is complete. The square root of 1,849 is 43.

Check: 43 × 43 = 1,849

Study the following carefully:

a.
```
  3  7
13 69
 9
67) 4 69
   4 69
```

b.
```
  4  5
20 25
16
85) 4 25
   4 25
```

c.
```
  9  3
86 49
81
183) 5 49
     5 49
```

Find the squares roots of these numbers:

1. 1,024	**4.** 2,809	**7.** 4,489	**10.** 2,601
2. 1,369	**5.** 3,844	**8.** 5,329	**11.** 3,721
3. 2,304	**6.** 2,025	**9.** 2,401	**12.** 5,184

Usually in finding the square roots of numbers there is a remainder after all of the periods have been brought down. The work is then carried to two or more decimal places, as shown in finding $\sqrt{619}$:

Annex a pair of zeros for each decimal place in the answer. Proceed as with whole numbers.

Note that 4 is contained in 21 five times. But 5×45 would have given 225, which is larger than 219. Therefore 4 is written as the second figure of the square root. Note the place of the decimal point in the answer $\sqrt{619} = 24.87$.

```
      2  4 . 8  7
    ------------------
    6 19 . 00 00
    4
  44)2 19
       1 76
 488)   43 00
        39 04
4,967)  3 96 00
        3 47 69
        ---------
          48 31
```

*Find the square roots of these numbers. Carry the work to one decimal place.

13. 527	**15.** 957	**17.** 5,186
14. 736	**16.** 834	**18.** 4,483

19. Find the square root of 153.2.

Suggestion: Point off the number into periods of two figures each, first going toward the right from the decimal point and then to the left of the decimal point. The number in the first period is 1. Add zeros to complete periods to the right of the decimal point.

```
)1 53.20 00
```

20. Find the square root of 756.4; 7.283.

Problems involving square roots. **1.** What is the length of the side of a square field containing 10 acres? (160 sq. rd. = 1 acre.) What is its perimeter?

***2.** Which has the larger perimeter, a square field containing 100 square rods, or a rectangular field of the same area, one of whose sides is 8 rods long? how much larger?

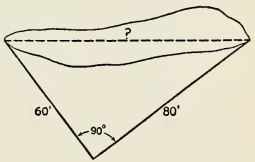
*3. The base of a rectangular tank is 12 feet long and 3 feet wide. What are the dimensions of the base of a tank whose base is a square of the same area?

*4. What is the length of the side of a square which has twice the area of a square with sides 12 feet long?

*5. If a window is 24 feet from the ground, how long must a ladder be in order to reach the window if the foot of the ladder is placed 8 feet from the wall?

*6. Fred wished to find the approximate height of his kite when 400 feet of string had been let out. He asked a friend to mark the place directly under the kite. Fred found that it was 180 feet from the mark to the place where he stood holding the kite string. Ignoring the sag of the string and Fred's height, find the approximate height of the kite from the ground.

*7. Find the length of this pond.



*8. In order to find out whether a corner is square, carpenters locate a point on one side 6 feet from the corner, and a point on the other side 8 feet from the corner. How far apart must the points thus located be to make the corner square? Try this as a class exercise.

*9. Using the method of computing square root which you have learned, find the length of the diagonal of this type page from *3 in the upper left corner to the end of the last line in the lower right corner. After you have solved the problem, check your work by measuring the diagonal with your ruler.

*10. Make up a problem which may be solved by the use of square root. Exchange your problem for a problem written by one of your classmates. Solve his problem.

PROBLEMS INVOLVING FORMULAS

1. What is the formula for the area of a square?

2. Find the side of a square if its area is 81 square feet.

3. The area of a square is 64 square inches. Find the length of one side.

4. The area of a circle is 154 square feet. Find its radius.

Think: $A = \pi r^2$, or $3\frac{1}{7} r^2$. Therefore, $154 = 3\frac{1}{7} r^2$.

Divide by $3\frac{1}{7}$, $49 = r^2$. $\sqrt{49} = r$, or $7 = r$.

The radius is 7 feet.

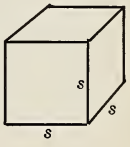
5. Use this method to find the radius of a circle whose area is $78\frac{4}{7}$ square inches.

6. Find the diameter of a circle whose area is $50\frac{2}{7}$ square yards.

7. The formula for the volume of a rectangular solid, whose base is a square with a side s, is $V = s^2h$. Find the length of the side of the square base of a solid, whose height is 5 inches, if its volume is 180 square inches.

8. Find the length of the side of the square base of a rectangular solid, if its height is 6 inches and its volume 150 square inches.

9. Express the volume of the cube at the right in terms of one of its sides.



Think: $V = s \times s \times s = ?$

10. What is the volume of a cube whose sides are 3 inches?

11. If the volume of a cube is 8 cubic inches, what is the length of a side?

Think: 8 = the product of what number used as a factor three times? You know that $8 = 2 \times 2 \times 2$. Hence, 2 indicates the length of a side.

12. Find the length of the side of a cube, if its volume is 64 cubic inches; 125 cubic feet; 216 cubic yards.

PASSING SOME SCOUT TESTS

Boy Scouts must be able to judge distance, size, weight, and height within 25% of the correct measurement. Boy Scouts measure their ability to estimate in the following way:

1. Jack estimated the height of a tree to be 50 feet. The true height was 60 feet. Was Jack's estimate within 25% of the true height?

Since Jack's estimate was 50 feet he was within the lower limit.

2. If Jack had estimated the height to be 80 feet, would he have passed the test?

3. Here are some estimates of the heights of telephone poles, and the true heights. Which of the estimates are within the 25% limit?

	Estimated Height	True Height
a. John	40 ft.	60 ft.
b. Keith	60 ft.	50 ft.
c. Dick	39 ft.	50 ft.
d. Myron	58 ft.	45 ft.

4. Jack's estimate of the distance between two trees was 18% above the true distance. If the true distance was 48 feet, what was Jack's estimate?

5. Arthur's estimate of the distance between two telephone poles was 15 feet more than the true distance. If the true distance was 90 feet, what was Arthur's estimate? Was his estimate within the 25% limit?

6. On his test of weight Jack estimated the weight of an iron bar to be $24\frac{1}{2}$ pounds. If the true weight was 30 pounds, was Jack's estimate within the 25% limit? What per cent of the true weight was his error of estimate?

***7.** See if you can estimate distances accurately enough to pass the Scout tests.

*OUTDOOR WORK

Miss Stokes asked pupils in her arithmetic class to prepare problems showing the use of geometry outside of school. Here are some of the problems.

1. Pace off a distance which you think is 100 feet. Check by measuring the distance. Pace off distances of 50 and 150 feet and check by measuring the distances. Compare the estimates of several persons in the class. How do you account for differences in estimates?

2. Estimate the distance around the trunk of a tree, and check by measuring the distance. Why is it not easy to estimate circular distances?

3. Estimate the width of a sidewalk in front of your school. Check your estimate by measuring. Would you expect to find larger per cents of error on short or on long distances?

4. Find the length of the block in which you live. Are blocks all of the same length?

5. Estimate the distance between two trees on your school grounds and check by measuring the distance.

6. Estimate the dimensions of a box and check by measuring them. Estimate the volume and check your estimate.

7. Estimate the area of a lot near your school. Check your estimate by measurement.

8. Find the capacity of a bin or a cereal package.

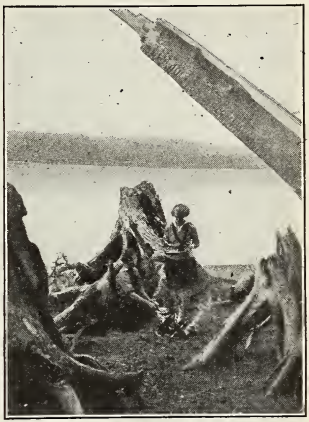
9. By reading the speedometer on an automobile, locate a place .5 mile from your school.

10. Measure the distance around the outer edge of an automobile tire.

11. Find the distance covered in one complete revolution of a wheel on a bicycle.

BUILDING AND EQUIPPING A CAMP

The Boy Scouts and the Girl Guides decided to build a summer camp on Lake Laura. The girls were to have the use of the camp during the month of July and the boys during the month of August. A committee, including the scoutmaster, was appointed to select a site, to prepare plans for the camp, and to estimate the cost of building and furnishing it.



Girl Guides cooking over an open fire.

Cost of excavating. They decided that there should be a basement under the house, 9 feet by 12 feet, and 5 feet underground. Contractors usually figure the cost of excavations at a certain amount a cubic yard. Their first problem was to find the number of cubic yards of dirt to be removed, and the cost of removing it at 75¢ a cubic yard. This was done as follows:

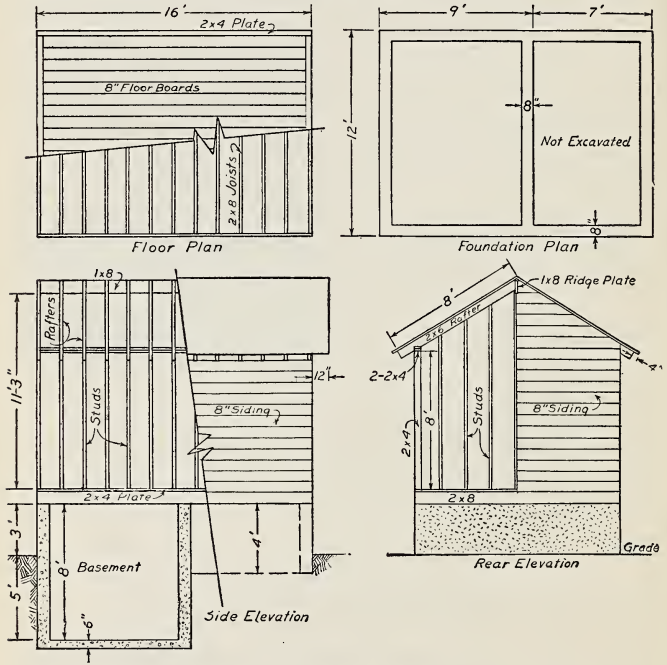
$9 \times 12 \times 5 = 540$, the number of cubic feet of dirt to be dug.
$540 \div 27 = 20$, the number of cubic yards of dirt.
$20 \times \$.75 = \$15$, the cost of excavating the basement.

1. What is the cost of excavating a cellar 25 feet wide, 30 feet long, and 6 feet deep, at 60¢ a cubic yard?

2. A contractor takes a job of digging a basement for $64. The basement is 20 feet wide, 24 feet long, and 5 feet deep. How much does he receive a cubic yard?

3. A labourer can excavate a cubic yard in two hours. In how many days of 8 hours each can he dig a basement 30 feet long, 18 feet wide, and 4 feet deep?

The plan of the camp. The committee secured a plan of their camp which looked like the sketch. The sketch



shows the floor plans, side, and a rear view of the camp.

Some of the boys and girls were not able to read and understand the plans. Can you? The test is your ability to answer the questions on the following pages.

1. In the floor plan the lines running vertically indicate the planks, or *joists*, upon which the floor boards are laid.

a. How many floor joists are needed?

b. What are the dimensions of the floor joists?

c. How many floor boards are needed?

d. What are the dimensions of the floor boards?

e. Notice the $2'' \times 4''$ *floor plate* running around the floor. How many $2'' \times 4''$ plates are necessary? How long are they?

2. Below the floor plan is given a plan showing a side view of the camp. Part of this view shows the roof and side boards removed. The dimensions which are lacking on this side view are found on the plan of the rear elevation. Refer to the plan of the camp building on page 228.

a. What is the distance from the floor plate to the *ridge plate?* The ridge plate is a board $1'' \times 8''$ shown at the top of the side elevation plan.

b. What is the height of the side wall?

c. If 8″ siding is used, how many boards are needed for the two side walls of the camp?

d. The *studs* are the $2'' \times 4''$ pieces upon which the siding is nailed. The studs run from the floor plates to the *rafters*. How many studs are needed?

e. How deep is the basement?

3. The rear elevation shows a rear view of the camp.

a. How high is it from the floor level to the rafters?

b. How high is it from the floor level to the peak of the roof?

c. How many boards are needed for siding? What are the dimensions of this siding?

d. How many studs are needed? Are they all of the same length? What lengths should the boys order?

Notice that no doors or windows are shown in this camp. They are not considered in estimating the material for a camp. The door will be made of the same material as the sides.

e. What are the dimensions of the roof? From what two plans do you get these dimensions?

The masonry work. The walls of the basement of the Boy Scout camp will be of concrete 8 inches thick and will rise 3 feet above the ground level. The basement floor will be 6 inches thick. The committee found that some contractors' rates are a certain amount a square yard, and that others base their rates on the number of cubic feet of concrete to be built. They found the approximate cost of the basement, using the square-yard method, in the following manner:

This cost is based upon an estimate of \$3.00 a square yard.

$2 \times 9 \times 8 = 144$ sq. ft. for the two side walls.
$2 \times 12 \times 8 = 192$ sq. ft. for the two end walls.
$9 \times 12 = 108$ sq. ft. for the floor.
$(144 + 192 + 108) \div 9 = 49\frac{1}{3}$ or $49\frac{1}{3}$ sq. yd. of wall and floor space.
$49\frac{1}{3} \times \$3.00 = \$148$, the cost of concrete walls and floor.

1. The committee then found the number of cubic feet of concrete which would be required for the walls and floor of the basement. If a contractor agrees to lay the concrete at 30¢ a cubic foot, what will be the cost of building the concrete walls and floor?

2. A basement is 24 feet wide, 30 feet long, and 7 feet deep. Find the cost of the concrete walls and floor at

$2.70 a square yard. Find the cost a cubic foot if the walls are 6 inches thick and the floor 6 inches deep.

3. If the walls were to be 8 inches thick, what would be the cost of building the cellar walls of bricks, allowing 20 bricks to a cubic foot of masonry, the cost of the bricks being $30 a M?

4. What is the cost of concreting a cellar 32 feet long, 22 feet wide, and 7 feet deep, at $2.50 a square yard?

5. If bricks were used in problem **4**, how many thousand bricks would be required if the walls were 8 inches thick and it required 22 bricks to a cubic foot?

Carpeting. The girls of the building committee decided to carpet the living room of the camp with old-fashioned rag carpets.

They learned that carpets were sold by the yard, and that in estimating the amount of carpet needed they must lay it so as to waste as little as possible. A part of a strip of carpet cannot be purchased.

The rag carpet to be used was $\frac{3}{4}$ of a yard wide. The practice used in finding the number of yards of carpet is as follows:

If the carpet is to run the length of the room, the number of strips needed is found by dividing the width of the room in yards by the width of the carpet in yards, allowing a whole strip for any fraction of a strip. The number of strips is then multiplied by the length of the room in yards.

If the carpet is to run the width of the room, the length of the room in yards is divided by the width of the carpet in yards.

1. Which is the more economical way of laying a rag carpet on the camp floor, which is 12 feet by 16 feet,

having strips run the length of the room or the width of the room? How many yards of carpet are saved?

2. If rag carpet costs 95¢ a running yard, what will be the cost of carpeting the room?

3. How much would it cost to cover the floor of your schoolroom with matting $\frac{3}{4}$ of a yard wide at \$.80 a yard? Which way should the strips run?

4. Linoleum is usually 2 yards wide, and may be sold by the linear yard. What will be the cost of placing linoleum on the camp floor at \$2.00 a linear yard?

5. Suppose that a $9' \times 12'$ rug has been given for the floor of the camp. They wish to lay a border of linoleum around the rug. How many square yards will be needed?

6. Find the cost of covering the floor of your classroom with linoleum at \$4.00 a linear yard.

Painting. It is difficult to estimate accurately the amount of paint to be used. Some surfaces require much more paint than others.

A common practice is to divide the number of square feet to be painted by 200. The quotient will show the approximate number of gallons of paint needed for two coats. No allowance is made for openings.

1. Using the method given above, what will be the cost of painting the outside of the building at \$2.50 a gallon? Each gable end is a triangle with a base of 12 feet and an altitude of 4 feet.

2. A painter usually covers about 1,000 square feet of wall a day. How long would it take him to apply two coats of paint to the camp?

***3.** If the inside walls and ceiling of your schoolroom were painted with a paint costing \$3.00 a gallon, and the painter received \$8.00 a day, how much would the job cost?

CUMULATIVE TEST VII

Use this test to discover the kind of examples in which you need practice.

1. 924 (*3*)
809
364
897
641
375
862
496

2. (*19*) $8\frac{1}{3} \div 5 =$

3. (*3*) 975 $\times 489$

4. (*3*) $974\overline{)86{,}597}$

(*12*)
5. $6\ \frac{3}{5}$
$8\ \frac{1}{2}$
$9\frac{9}{10}$

(*14*)
6. $37\frac{1}{3} - 18\frac{1}{2}$

(*17*)
7. $9\frac{3}{4} \times 6 \times \frac{8}{9} =$

8. $5\frac{1}{4} \div \frac{7}{8} =$ (*19*)

9. 68.4 (*26*) $\times$ 5.76

10. (*27*) $4.8\overline{)964}$

11. (*25*) $8.7 + 95 + .6 =$

12. (*152*) If $\frac{x}{6} = \frac{7}{8}$, x equals ——

13. (*35*) \$.15 = 12% of ——

14. What is 8% of \$748.50? (*34*)

15. 120% of what number equals 360? (*35*)

16. Change $\frac{15}{16}$ to per cent. (*28*)

Solve for x in **17** and **18**.

17. $x - 7 = 14$. (*151*)

18. $3x + 2 = 11$. (*157*)

19. 75 = —% of 250? (*35*)

20. Draw two similar triangles. (*200*)

21. Find the square root of 2,025. (*221*)

22. Find the sum of 48.6, 59.75, 96, and 787.4. (*25*)

23. Subtract 9.6745 from 987.46. (*25*)

24. 4.5% of 684 = ? (*34*)

25. Find the value of x in the equation, $3x - 5 = 7$. (*157*)

Do not be satisfied until you can work all of the examples correctly.

PRACTICE TESTS

Practise the examples in each set until you can work all of them correctly in the time allowed. Keep a record of your daily scores. Always try to better your record on previous tests.

PRACTICE TEST IN FRACTIONS VI (8 minutes)

1. $\frac{3}{5} + \frac{1}{2} + \frac{3}{4} =$
2. $9\frac{1}{8} - \frac{1}{4} =$
3. $7 \times 4\frac{1}{2} =$
4. $18 \div \frac{8}{9} =$
5. $24 \times 3\frac{1}{8} =$
6. $\frac{5}{6} \div \frac{5}{8} =$
7. $\frac{1}{2} \times \frac{8}{9} =$
8. $4\frac{1}{5} + 9\frac{1}{4} =$
9. $\frac{4}{9} \div 4 =$
10. $8\frac{1}{4} - 4\frac{2}{3} =$
11. $10 \div 2\frac{1}{2} =$
12. $6\frac{7}{8} - 2\frac{11}{12} =$
13. $3\frac{1}{5} \times \frac{3}{8} \times \frac{8}{9} =$
14. $\frac{5}{12} + 1\frac{1}{3} + 8 =$
15. $2\frac{2}{3} \div 3\frac{1}{3} =$

PRACTICE TEST IN DECIMALS VI (8 minutes)

1. $7 \times .9 =$
2. $.04 + .02 + .01 =$
3. $19.269 - 9 =$
4. $.54 - .51 =$
5. $1.8 \div 36 =$
6. $1.73 + 2.65 + 4.93 =$
7. $1.2 \div .24 =$
8. $3 \times 1.245 =$
9. $8.052 - 7.32 =$
10. $39.65 - 7.8 =$
11. $1.1 \times 2.32 =$
12. $9.684 + 20 + .4 =$
13. $10.5 \times 1.56 =$
14. $5.852 - 5.8 =$
15. $13.75 \div .125 =$
16. $1{,}000 \times 7.64 =$

PRACTICE TEST IN PER CENT VI (8 minutes)

1. $.37\frac{1}{2} =$ —%
2. $.6 =$ —%
3. $\frac{1}{2}\% =$ — decimal
4. $\frac{1}{6} =$ —%
5. 30% of \$7.20 =
6. 15 = —% of 90
7. $2\frac{1}{2}\%$ of \$750 =
8. 5% of — = 24
9. 60 = —% of 50
10. 25% of — = \$3.60
11. 3.4% of 728 =
12. \$1.00 = —% of \$100
13. $166\frac{2}{3}\%$ of \$9.36 =
14. 9 = 12% of ——
15. —% of 64 = 40
16. 4% of \$7.25 =

USING MATHEMATICS IN BUSINESS

1. The following advertisement appeared in a daily newspaper:

WARDROBE TRUNKS

at $\frac{1}{3}$ off

These drastic price reductions present a most remarkable buying opportunity. Take advantage of them.

Quantity	Model	Reduced Sale Price
2	Steamer	$15.00
12	$\frac{3}{4}$ size	23.00
1	Steamer	25.00
1	$\frac{3}{4}$ size	26.67
1	$\frac{7}{8}$ size	32.50
2	Full size	36.67
1	Golfer	50.00

What was the original price for each trunk?

2. A salesman sold goods at a commission of 35% on his sales. During three months his receipts were: June $725, July $850, August $790. What was his commission each month? What was his total commission during the summer?

3. Peter had saved $50 in a bank vacation club toward a two-weeks' camping trip with five other boys. Before he left, his father gave him $10 more. His expenses for the trip were as follows: railroad ticket $5.50, share of camp expenses $20, blanket $7.50, hunting boots and slicker $13, fishing tackle $4.25. What per cent of his money was left?

4. Which costs less, a rug 9 feet by 12 feet at $43, or the same amount of yard-wide carpet at $4.00 a yard?

5. If a retail merchant gets a discount of 20 per cent on a bill of goods listed at $100, and then sells the goods for the list price, what per cent of the cost does he add to establish his selling price?

6. If a retail merchant gets a discount of $33\frac{1}{3}$ per cent from the list price, and sells at the list price, what per cent of the cost does he add to the cost?

7. Prepare an invoice for the goods listed at the right. Use any firm name you wish.

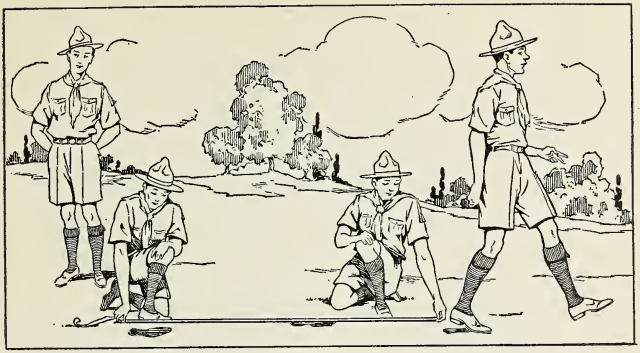
425 pr. hose	@	$0.87\frac{1}{2}$
275 pr. men's hose	@	$.22\frac{2}{9}$
750 pr. children's hose	@	$.37\frac{1}{2}$
765 men's shirts	@	1.25
600 jumpers	@	$.62\frac{1}{2}$

8. In writing to school boards about a teaching position, an applicant stated that he hoped the school board would deal directly with him if a vacancy occurred, rather than through a teachers' agency which charges 5% of the year's salary for securing positions for teachers. The teacher stated that he would save $100 commission by dealing directly with the school board. What annual salary did he expect to receive?

9. The annual sales of a book supply company are $1,000,000. Their overhead expenses are 22% of their total sales. Their profits are 10% of their total sales. What is the cost of the goods they sell annually?

10. Find the net amount of the articles at the right if the prices are subject to a trade discount of $33\frac{1}{3}$% and 10%.

12 golf drivers	@	$12.00
10 brassies	@	9.00
18 midirons	@	7.00
50 doz. golf balls	@	3.00



SECTION VIII

HOW LONG IS YOUR STRIDE?

A boy scout is required to know the length of his *stride.* In the picture, Ned is pacing off a distance of 200 feet which Tom has just measured with his tape. In measuring his stride the scout steps off with his left foot and counts only the strides of the right foot. There are two paces or steps in a stride. Look up in a dictionary the two different meanings of the word *stride.*

1. In his first trial in walking 200 feet, Ned took 41 strides, in the second 39, and in the third 40. What was the average number of strides Ned took? What was the average length of his stride?

2. Tom, who is not so tall as Ned, has a stride of $4\frac{1}{2}$ feet. How many strides will he take in walking 270 feet?

3. Charles took 48 strides in walking 200 feet. What was the length of his stride?

4. How much shorter is Charles' stride than Tom's?

5. Harry, Jim, Sam, and George have just measured the length of their strides. They are as follows: Harry's

$4\frac{3}{4}$ feet, Jim's $4\frac{5}{6}$ feet, Sam's $5\frac{1}{4}$ feet, George's $5\frac{2}{3}$ feet. What is the average length of their strides?

*6. Harry has a staff $5\frac{1}{2}$ feet long. How many lengths of this staff will make a rod?

*7. A Boy Scout troop decides to measure a rectangular piece of land one acre in area. They pace off 16 rods for the length. How many rods wide must they make the field to have it contain the required area?

A bit of history. You will be interested to learn how some of our common units of measure came to be used. The human foot was early used as a unit of measure. From it we get the *foot* as a measure of length. The length of the arm of Henry I, who was king of England about A.D. 1100, was made the standard yard. The foot was then made one third of the yard.

Later a metal yardstick was made to be used as the standard yard. Replicas of this are now kept in the capitals of the various countries of the world.

During the French Revolution a new system of weights and measures was devised by a committee of the Academy of Sciences, acting under the direction of the National Assembly of the French Republic. The standard of length selected was $\frac{1}{10000000}$ of the distance from the pole to the equator measured along the meridian that passes through Paris. This unit, called the *meter*, was adopted as the standard of length by the French Government in 1799. It has since been adopted with the other units of the metric system in practically all the countries of the world with the exception of the United States and the British Empire. It is used as the unit of measure in all scientific investigations.

USING THE METRIC SYSTEM

The part of the ruler below has an upper and a lower scale. What fraction of an inch is the smallest division on the upper scale? What part of an inch is each of the other divisions?

The divisions in the lower scale are different from those in the upper scale. The large divisions are called *centimeters* and the smaller divisions are called *millimeters*.

This method of measuring is called the *metric system*. Three prefixes of Greek origin are used to represent multiples of the meter, namely: deca (10); hecto (100); kilo (1,000). Three prefixes of Latin origin are used to represent fractional or decimal divisions, namely: deci ($\frac{1}{10}$); centi ($\frac{1}{100}$); milli ($\frac{1}{1000}$). The most common linear units in this system and their equivalent values are:

10 millimeters (mm.)	= 1 centimeter (cm.) =	.3937 inches
10 centimeters	= 1 decimeter (dm.) =	3.937 inches
10 decimeters	= 1 meter (m.) =	39.37 inches
10 meters	= 1 decameter (Dm.) =	393.7 inches
10 decameters	= 1 hectometer (hm.) =	3937 inches
10 hectometers	= 1 kilometer (km.) =	39370 inches

1,000 meters = 1 kilometer = .62137 of a mile.

When it is necessary to convert one unit in the metric system to another unit in the same system, the fact that the metric system is a decimal system enables us to make the change by simply moving the decimal point to the right or left a desired number of places.

1. Give the number of inches in a decimeter correct to two places; to one place.

2. Which unit of the metric system approximates a yard?

3. Show that the metric system is a decimal system.

4. 1 decimeter = —— meter.

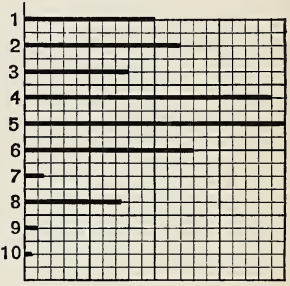
5. 1 centimeter = —— decimeter = —— meter.

6. 2 decimeters, 4 centimeters = .24 meter. Why?

7. Change 4 decimeters, 5 centimeters to meters.

8. 5 millimeters = —— decimeter = —— meter.

9. In the figure at the right, each small horizontal division represents two millimeters. State the number of centimeters in each line; the number of millimeters.



10. In the 1936 winter Olympics the 10,000-meter speed-skating contest was won by Ballangrud of Norway, in 17:24.3. The American record for six miles at that time was 18:38, held by Johnson, of Montreal. How much faster a mile was the Olympic record than the American record?

11. In the 50-kilometer ski cross-country race, Elis Viklund of Sweden won in 3 hours 30 minutes 11 seconds. How many miles is 50 kilometers (disregard fraction)?

***12.** Express your height in centimeters.

***13.** The metric system also has units for measuring area, volume, weight, and liquid measure. Make a report to the class about these units of measure.

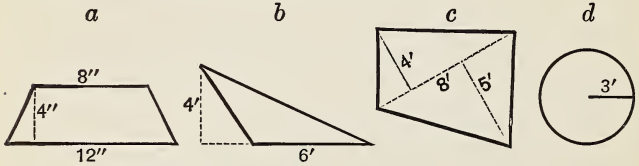
REVIEW OF CONSTRUCTIONS

On the blackboard or on your papers, be ready to show the method of doing each of the following:

1. Constructing a circle.
2. Constructing two concentric circles.
3. Measuring lengths of lines with compasses.
4. Drawing to scale.
5. Measuring angles.
6. Constructing an angle with a protractor.
7. Constructing with compasses an angle equal to a given angle.
8. Constructing right angles.
9. Bisecting an angle.
10. Dividing an angle into four equal angles.
11. Bisecting a line.
12. Constructing a perpendicular bisector of a line.
13. Constructing a perpendicular to a line from a point without the line.
14. Constructing two parallel lines.
15. Constructing a line parallel to a given line.
16. Making a copy of a given triangle.
17. Constructing a triangle when given the lengths of the three sides.
18. Constructing an angle equal to a given angle.
19. Constructing an equilateral triangle.
20. Constructing an isosceles triangle.
21. Drawing two similar triangles or rectangles.
22. Constructing a hexagon.
23. Drawing two congruent triangles.
24. Constructing a square.
25. Constructing a rectangle.
26. Inscribing a square in a circle.

TESTING FACTS YOU HAVE LEARNED IN GEOMETRY

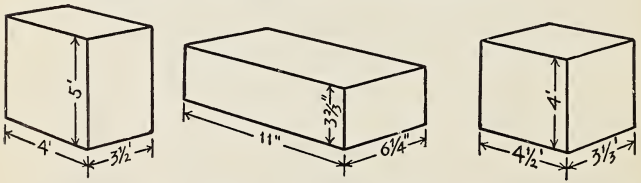
1. Draw an angle of 50°.
2. Bisect the angle.
3. Draw two parallel lines each $2\frac{1}{2}$ inches long.
4. Draw a line of convenient length. Bisect it.
5. Construct a perpendicular to a line at a given point.
6. Find the areas of the following:



7. Find the area of the walls and ceiling of a room 18 feet long, 12 feet wide, and 9 feet high.

8. What is the circumference of a circle whose diameter is 14 inches?

9. Find the volumes of the following solids:



10. Find the height of a solid whose volume is 1,728 cubic inches if its length is 12 inches and its width is 12 inches.

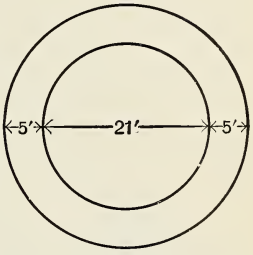
11. Draw a figure to a scale of 1 inch to 10 feet to represent a room 15 feet long and $12\frac{1}{2}$ feet wide.

12. Draw a rectangle and another parallelogram having the same area.

PRACTICAL USES OF CIRCLES

1. A smokestack is 66 feet in circumference at the ground. Find the diameter of the stack at that point.

2. A five-foot sidewalk is to be built around a fountain 21 feet in diameter. Find the area of the sidewalk.

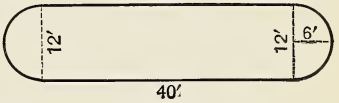


3. An emery wheel makes 1,000 revolutions a minute. Its diameter is 20 inches. Find the speed of the edge of the wheel.

4. How many revolutions a mile does a locomotive wheel make, if it is 70 inches in diameter? How many revolutions does it make in a 300-mile trip?

5. Find the area of a circular garden plot the circumference of which is 44 feet.

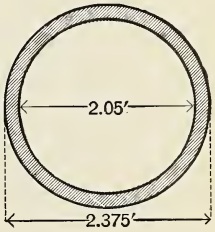
6. Find the perimeter of the playground at the right.



7. Find the area of the playground.

8. The diameter of the piston in a certain automobile engine is $3\frac{7}{8}$ inches. What is the area of the head of the piston?

9. A pipe used as a conduit for telephone wires has the dimensions indicated in this figure. How thick is the pipe?



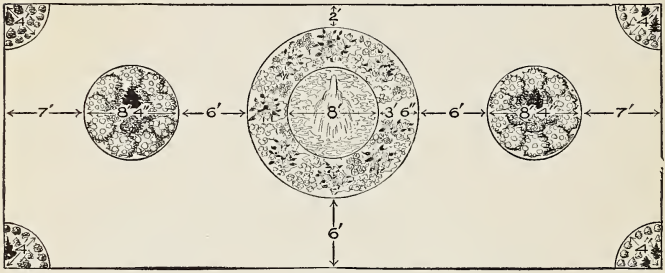
10. The diameter of the piston of a steam engine is 14 inches.

a. Find the area of the head of the piston.

b. Find the total pressure on the head of the piston if the steam pressure is 100 pounds to the square inch.

11. Which has the greater area, a circle with a diameter of 10 feet or a square 9 feet on a side?

12. How many revolutions a mile are made by the wheel of a bicycle 2 feet 4 inches in diameter?



13. *a.* Make a larger drawing of the garden plan above. To what scale will you draw your plan?

b. What is the diameter of the large centre plot?

c. What is the area of the fountain?

d. What is the area of the flower bed around the fountain?

e. What is the area of the two smaller circular flower beds?

f. Find the length of the whole garden; the width.

g. What is the total area?

h. What is the area of the four corner plots?

i. What would be the cost of sodding the garden, exclusive of the flower beds and shrubbery, at 25 cents a square foot?

USING ARITHMETIC, ALGEBRA, AND GEOMETRY

Whenever we use short-cut methods for stating rules, such as $A = lw$, we are using *algebra*.

Algebra uses the processes of arithmetic and the same signs: $+$, $-$, $\times$, $\div$. An important thing to remember about algebra, especially in formulas, is that two letters or letters and figures, written side by side, are to be multiplied. Thus, lw means l times w; $2r$ means 2 times r.

After you have given the word answers to the following problems, write simple formulas for the answers, substituting letters for words.

1. If you have the base and altitude of a triangle, how do you find the area?

2. If you have the base and altitude of a rectangle, how do you find the area?

3. If you are given the base and altitude of a parallelogram, how do you find the area?

4. How do you find the perimeter of a triangle? of a rectangle? of a square?

5. If you know the scale of miles to an inch to which a map is drawn, how do you find the distance between two places on the map?

6. If you know the diameter of a circle, how do you find its area? its circumference?

7. If you know the two bases of a trapezium and its altitude, how do you find its area?

8. If you know the distance travelled and the time required for travelling, how do you find the average speed per unit of time?

9. If you know the average number of miles an automobile can travel an hour, how do you find the length of time needed to travel a given distance?

SHORT REVIEW EXERCISE

Find the missing numbers in the following:

1. *Rectangles*

	Length	Width	Area
a.	8 in.	7 in.	?
b.	$7\frac{1}{2}$ ft.	$3\frac{1}{2}$ ft.	?
c.	7.5 rd.	12.4 rd.	?
d.	10 in.	?	120 sq. in.

2. *Triangles*

	Base	Altitude	Area
a.	3 in.	4 in.	?
b.	$1\frac{1}{2}$ ft.	3 ft.	?
c.	6 yd.	7.9 yd.	?
d.	?	6.4 in.	32 sq. in.

3. *Parallelograms*

	Base	Altitude	Area
a.	75 ft.	30 ft.	?
b.	$6\frac{1}{2}$ in.	$\frac{3}{4}$ in.	?
c.	16.25 ft.	8.4 ft.	?
d.	3.725 yd.	6.84 yd.	?

4. *Circles*

	Diameter	Circumference	Area
a.	3 in.	?	?
b.	7 in.	?	?
c.	21 ft.	?	?
d.	6.3 in.	?	?

5. *Rectangular solids*

	Length	Width	Height	Volume
a.	4 in.	3 in.	7 in.	?
b.	$1\frac{1}{2}$ ft.	$1\frac{1}{4}$ ft.	$2\frac{1}{3}$ ft.	?
c.	18 ft.	?	4 ft.	720 cu. ft.
d.	?	3.2 in.	5.4 in.	43.2 cu. in.
e.	$5\frac{1}{4}$ ft.	$2\frac{1}{2}$ ft.	?	35 cu. ft.

6. Find the perimeters of the rectangles in **1.**

7. Find the area of a trapezium whose parallel sides are 4.5 inches and 3.6 inches and whose altitude is 2.5 inches.

*COST OF RUNNING A MEAT MARKET

Harry Andrews was planning to open a meat market of his own. He did not know much about the business of a meat market, so he looked up information concerning the cost of operating one.

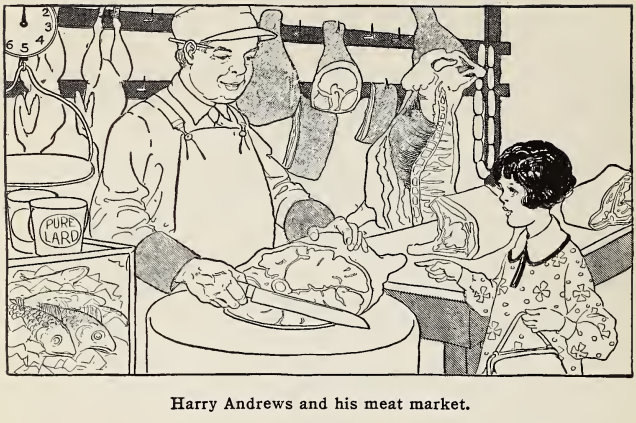
He found that a certain university had published a report of the expenses of 471 retail meat markets, showing them to be divided as follows:

	Per Cent
Salaries and wages	10.6
Advertising	0.35
Boxes and wrappings	0.6
Delivery	1.2
Office supplies and postage	0.15
Rent	1.3
Heat, light, and power	0.3
Taxes and licenses	0.2
Insurance	0.15
Repairs	0.1
Depreciation of store equipment	0.3
Interest	1.0
Miscellaneous expenses	0.7
Losses from bad debts	0.35
Total expenses	17.3
Gross profit on volume of business	19.1
Net profit on volume of business	1.8
Turnover of stock (10.1 times a year)	

The per cents given in the table show what part of the money paid for meat by the customers of the store is spent for the purposes given in the table.

1. Explain the different items in the table. For example, how much is spent for salaries and wages? What does this item mean?

2. How was 17.3 per cent, the total expenses of the meat market, found?



Harry Andrews and his meat market.

3. How was 1.8 per cent, the net profit, found?

4. How much of the dollar you spend for meat is spent by the manager of the market for rent? for salaries and wages? for each of the remaining items?

5. If each customer carried home his own meat, by what per cent would the total expenses be reduced?

6. What per cent of the total amount received for the meat does the butcher spend for the meat itself? You can find this by subtracting the per cent of gross profits from 100 per cent.

7. If the volume of business of a meat market for a year is $100,000, what are the net profits?

***8.** What must be the volume of business for a year to produce a net profit of $5,760?

***9.** If the volume of business of a meat market is $100,000 a year, how much is spent for each of the purposes listed in the table on page 247?

*MARKING SELLING PRICES

John Olsen worked in the stock department of a men's clothing store. One of his duties was to mark the prices on goods. One day he was interested in finding the amount the dealer added to the cost in deciding what the selling price was to be. He examined a list of goods which gave both the cost and the selling price. Here is a part of a list that he saw.

Article	Cost	Selling Price
Boys' suits, Lot 1..	$7.50	$10.00
Boys' suits, Lot 2..	8.00	11.00
Boys' suits, Lot 3..	9.00	12.00
Boys' overcoats....	10.00	14.00
Girls' coats	12.00	17.50

1. What was the difference between the cost and selling price of boys' suits, Lot 2? What per cent was this of the cost?

Think: $\frac{3.00}{8.00} = \frac{3}{8} =$? per cent?

The dealer's margin was what per cent of the cost?

2. What per cent of the cost is the difference between the cost and selling price for Lot 3?

3. Find the per cent of margin for Lot 1, based on the cost.

4. Find the per cent of margin for boys' overcoats, based on the cost.

5. Find the per cent of margin for girls' coats, based on the cost.

6. At a sale later on, John was told to mark the clothing at only 10 per cent above the cost. What was the new selling price of each kind of garment?

7. Later he was told to mark the clothes at 5 per cent below cost. What was the selling price of each kind of garment at this reduction?

8. Would the dealer's profit on the suits in Lot 1 be $2.50 a suit at the prices listed in the table? Explain.

Find the missing numbers in the following:

	Cost	Selling Price	Gross Profit	Per Cent Gross Profit Is of Selling Price
9.	$5.00	$7.50	?	?
10.	$3.00	?	$2.50	?
11.	?	$10.00	$2.00	?
12.	?	$9.60	$1.60	?
13.	$12.50	$16.00	?	?
14.	?	?	$2.00	10%
15.	?	?	$5.00	20%
16.	?	$1.50	?	10%
17.	?	$1,000	$60	?
18.	$17.50	$20.00	?	?
19.	?	$640	?	5%

IMPORTANT POINTS ABOUT BUSINESS

Study the following questions carefully and be ready to explain your answer:

1. Which is greater when there is a gain, the cost or the selling price?

2. Which is greater when there is a loss, the cost or the selling price?

3. What is meant by total cost? by margin? by gross profit? by net profit? by overhead?

4. If you know the selling price and the loss, how can you find the cost?

5. What is trade discount?

6. If you know the list price and the rate of discount, how can you find the selling price?

7. Is the rate of profit larger when computed on the cost than when computed on the selling price?

8. What must you know to find the amount of profit a dealer makes in a year?

9. Why are people paid commissions? How are commissions computed?

10. What is meant by net proceeds?

11. What is meant by interest? principal?

12. How would you make an inventory of your personal belongings?

13. How do banks help the business man?

14. What is a bill? an account? a statement? a premium? a policy?

15. What facts are given in a cheque?

16. How does a current account differ from a savings account?

***17.** What are the names of the largest banks in Canada? What are branch banks?

EXPLAINING THE USE OF FORMULAS

Explain each of the following formulas:

1. $A = lw$
2. $A = \pi r^2$
3. $C = 2\pi r$
4. $V = lwh$
5. $C = \pi d$
6. $V = s^2h$
7. $A = \frac{1}{2}ab$
8. $A = ba$
9. $A = \frac{1}{2}a(b + c)$
10. $A = s^2$
11. $p = 2l + 2w$
12. $C = np$
13. $I = Prt$
14. $V = s^3$
15. $p = 4s$

16. Write problems that can be solved by using these formulas. Then solve the problems.

CUMULATIVE TEST VIII

Work these examples in fifteen minutes:

1. 875 (*3*)
   876
   594
   783
   655
2. $98{,}002$ (*3*)
   $-79{,}163$
3. 587 (*3*)
   $\times 908$
4. $468\overline{)444{,}600}$ (*3*)
5. $8\frac{7}{8} + 9\frac{5}{6} + 6\frac{3}{4} =$ (*12*)
6. $24\frac{4}{5} - 16\frac{9}{10} =$ (*14*)
7. $9\frac{1}{2} \times 27 =$ (*17*)
8. $4\frac{1}{8} \div 2\frac{1}{16} =$ (*19*)
9. $1.8 + 1.75 + 23.7 =$ (*25*)
10. $36.5 - 2.75 =$ (*25*)
11. $3.75 \times 9.84 =$ (*26*)
12. $13.892 \div .46 =$ (*27*)
13. Change $\frac{7}{12}$ to a three-place decimal. (*28*)
14. Express 5% as a fraction and as a decimal. (*31*)
15. Find 8% of \$3,750. (*34*)
16. \$12.50 = —% of \$10. (*35*)
17. 25 = 5% of ——. (*35*)
18. Find the square root of 324. (*216*)
19. Construct a circle having a 4-inch diameter. (*Gd. VII*)
20. What is the area of the circle? its circumference? (*Gd. VII*)

Solve for x in the following:

21. $4x = 16$ (*144*)
22. $x - 4 = 8$ (*151*)
23. $x + 7 = 16$ (*150*)
24. $\frac{x}{4} = \frac{3}{4}$ (*152*)
25. $3x - 2 = 13$ (*157*)

PROBLEM SCALE V

1. How many blouse lengths of $2\frac{1}{2}$ yards each can be cut from 20 yards of cloth?

2. During its first year Mr. Myers' new car used one gallon of gasoline for each 19.6 miles travelled. In the second year it used one gallon for each 17.9 miles. How much farther than during the second year did the car travel the first year for each 10 gallons of gasoline which it used?

3. If 520 rods of fence are required to inclose a rectangular field measuring 100 rods in length, what is the width of the field?

4. Mr. Smith's property is valued at \$7,500. It is assessed for $\frac{2}{3}$ of its value. How much does he pay in taxes if the rate is 12 mills?

5. A boy rode 27 miles on a bicycle in $2\frac{1}{2}$ hours. At the same rate, how far can he ride in 4 hours?

6. I buy 96 apples for \$1.50 and sell them at 25 cents a dozen. What per cent of the cost is the gross profit?

7. If a ton of coal occupies 35 cubic feet, how many tons can be put in a bin 14 feet square and 8 feet deep?

8. The tax rate in our city in a recent year was \$.062. If Mr. A's property was valued at \$8,500 and was assessed at 50% of its value, what was the amount of his taxes?

9. A dairyman sold 800 pounds of milk to the creamery. The milk tested 4.1% butterfat. If he was paid 36.4 cents a pound for the butterfat from the milk, how much did he receive?

10. A man sells a house for \$8,750. The purchaser agrees to pay \$3,000 down and the remainder in monthly instalments of \$50, plus interest at 6%. How much does he pay at the end of the first month?

SURVEY OF THE YEAR'S WORK

Set I

1. A swimming pool is 80 feet long and 60 feet wide. The water in it is on the average 5 feet deep. How long will it take to empty the pool if the water runs out at the rate of 100 cubic feet a minute?

2. John's father sent him to the basement to measure the coal bin. The measurements were 16′ long, 8′ wide, and 7′ high. How many tons of coal, 35 cubic feet to a ton, can be stored in the bin?

3. Tom measured his father's potato bin. It is 6 feet long, 4 feet wide, and 2 feet high. How many bushels will it hold? How much would it cost to fill the bin if potatoes cost $1.50 a bushel? Allow $1\frac{1}{4}$ cubic feet to a bushel.

4. By measuring the coal bin at home Anna learned that it is 10 ft. by 5 ft. by 7 ft. How much will it cost to fill it with coal at $16 a ton? Allow 35 cubic feet to a ton.

5. A man's salary is $180 a month. He spends $80 for household expenses, $60 for rent, $6.00 for car fare, $20 for incidentals, and saves the rest. Make a circle graph to represent these facts.

6. If you agree to pay 40 per cent of the expenses of an automobile trip and they amount to $64, how much do you pay?

7. The four faces of a church spire are triangles. The base of each triangle is 18 feet and the altitude 54 feet. How many square feet of roofing are required to cover the spire?

8. A tailor agreed to line a coat for $20. He used 3 yards of material at $3.50 a yard. He paid a helper $.45 an hour for 4 hours work. How much did he gain?

9. At a "20-per-cent-off" sale Mrs. Smith bought a $75 bookcase. How much did she pay for the bookcase?

Set II

1. At $.30 a yard, how much will it cost to build a fence around a garden 40 feet long and 26 feet wide?

2. James Brown borrowed a sum of money today from the Lincoln Trust Company, giving as security a 60-day note for $300. Write the note. How much is the amount of the note at time of payment, if interest is 6%?

3. A class cleared $78.60 on an entertainment and gave 55% of this amount to charity. With the remainder of their money they made a payment on a 'cello for the school orchestra. What was the amount of the payment?

4. A cattle dealer sold a shipment of cattle weighing 25,750 pounds, for $15.24 a hundred pounds. How much did he receive for the cattle?

5. On March 17, 1927, Walter Harris bought from the James C. Williamson Co. an automobile for $4,500. He paid $3,000 cash, and for the remainder of the cost gave a promissory note for 3 months, with interest at 6%. Write the note and find the amount due on it at maturity.

6. A 3-months' note for $1,400, dated July 15, was paid August 10, with interest at $5\frac{1}{2}$%. Find the time and the amount.

7. Find the circumference of the largest circle that can be cut from a sheet of tin 14 inches long and 9 inches wide.

8. How much will it cost to inclose a 10-acre square field with fencing at $.25 a linear foot?

9. One piece of land is a rectangle, 40 rods by 25 rods; another is 18 rods square. Find the difference in the cost of fencing them at $1.25 a rod.

Set III

1. A park has a rectangular wading pool 30 feet long, 20 feet wide, and 3 feet deep. How much will it cost to cement the sides and bottom at 17¢ a square foot?

2. How much will it cost to cover a surface 3 feet by 9 feet with blackboard at 25¢ a square foot?

3. Mary and Jane each had $200. Mary deposited her money in a savings bank at 4%, compounded quarterly. Jane's father borrowed her money at 4%, simple interest. At the end of one year what was the difference in the amounts due Mary and Jane?

4. Mr. Grayson owns a house. The taxes and other expenses amount to $175 annually. He can rent it for $40 a month, or sell it for $5,000 and invest the money at 6%. Which will give him the greater net income?

5. My property valued at $6,000 is assessed for 40% of its value. If the tax rate is 69.3 mills, how much tax must I pay?

6. Three boys went on a camping trip. Their expenses were $16. One remained a week, another 10 days, and the third 15 days. How much should each pay?

7. A homing pigeon can fly 1,200 yards a minute. How many miles can he fly in an hour?

8. Helen measured the kitchen of her home and learned that it was 12 feet long and 10 feet wide. How much will it cost to cover the floor with linoleum at $2.00 a yard? (The linoleum is 2 yards wide.)

9. A 100-year lease on some city property was purchased recently at $6,000 a front foot. The property has a frontage of 167 feet and is 125 feet deep. Find the approximate cost. Find the value a square foot.

TABLES OF MEASURES

For Reference

Counting

12 things = 1 dozen
12 dozen = 1 gross
20 things = 1 score

Capacity

Liquid Measure

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
231 cubic inches = 1 wine gallon
277.274 cu. in. = 1 imperial gallon

Dry Measure

2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel
2,218.192 cubic inches = 1 bushel

Weight

Avoirdupois Weight

16 ounces = 1 pound
100 pounds = 1 hundredweight (cwt.)
2,000 pounds or 20 hundredweight = 1 ton
2,240 pounds = 1 long ton
1 pound = 7,000 grains (troy)
196 pounds = 1 barrel of flour
62.5 pounds = 1 cubic foot of water
60 pounds = 1 bushel of wheat or potatoes
56 pounds = 1 bushel of corn or rye

Troy Weight

For jewels and precious metals

24 grains = 1 pennyweight (pwt.)
20 pennyweights = 1 ounce
12 ounces = 1 pound
5,760 grains = 1 pound (troy)
7,000 grains = 1 pound (avoirdupois)

Length

12 inches = 1 foot
3 feet = 1 yard
16½ feet, or 5½ yards = 1 rod (pole or perch)
5,280 feet
1,760 yards
320 rods
} = 1 mile
4 inches = 1 hand
6 feet = 1 fathom
1.151 common miles = 1 knot
360 degrees = 1 circle

Surface or Square Measure

144 square inches = 1 square foot
9 square feet = 1 square yard
30¼ square yards = 1 square rod
160 square rods or 43,560 square feet = 1 acre
640 acres = 1 square mile, or 1 section
36 sections = 1 township

Solid or Cubic Measure

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard

Wood measure

16 cubic feet = 1 cord foot
128 cubic feet, or
8 cord feet = 1 cord
24¾ cubic feet = 1 perch of stone

Time Measure

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
365 days = 1 year
366 days = 1 leap year

Metric System (Equivalents)

10 millimeters = 1 centimeter
100 centimeters = 1 meter
1,000 meters = 1 kilometer

1 inch = 2.54 centimeters
1 foot = 30.48 centimeters
1 yard = 0.9144 meter
1 mile = 1.6093 kilometers

Equivalents

6¼ gallons = 1 cubic foot
1 bushel oats = 34 pounds
¼ peck potatoes = 3 pounds 12 ounces
1 gal. water at any temperature weighs approximately 10 lb.
1 ton coal = 35 cubic feet (approximately)
£ Sterling = $4.86\frac{2}{3}$

Compound Interest Tables

Periods	2%	2½%	3%	4%	5%	6%	7%
1.....	1.02000	1.02500	1.03000	1.04000	1.05000	1.06000	1.07000
2.....	1.04040	1.05063	1.06090	1.08160	1.10250	1.12360	1.14490
3.....	1.06121	1.07689	1.09273	1.12486	1.15763	1.19102	1.22504
4.....	1.08243	1.10381	1.12551	1.16986	1.21551	1.26248	1.31080
5.....	1.10408	1.13141	1.15927	1.21665	1.27628	1.33823	1.40255
6.....	1.12616	1.15969	1.19405	1.26532	1.34010	1.41852	1.50073
7.....	1.14869	1.18869	1.22987	1.31593	1.40710	1.50363	1.60578
8.....	1.17166	1.21840	1.26677	1.36857	1.47746	1.59385	1.71819
9.....	1.19509	1.24886	1.30477	1.42331	1.55133	1.68948	1.83846
10.....	1.21899	1.28008	1.34392	1.48024	1.62889	1.79085	1.96715
11.....	1.24337	1.31209	1.38423	1.53945	1.71034	1.89830	2.10485
12.....	1.26824	1.34489	1.42576	1.60103	1.79586	2.01220	2.25219
13.....	1.29361	1.37851	1.46853	1.66507	1.88565	2.13293	2.40985
14.....	1.31948	1.41297	1.51259	1.73168	1.97993	2.26090	2.57853
15.....	1.34587	1.44830	1.55797	1.80094	2.07893	2.39656	2.75903
16.....	1.37279	1.48451	1.60471	1.87298	2.18287	2.54035	2.95216
17.....	1.40024	1.52162	1.65285	1.94790	2.29202	2.69277	3.15882
18.....	1.42825	1.55966	1.70243	2.02582	2.40662	2.85434	3.37993
19.....	1.45681	1.59865	1.75351	2.10685	2.52695	3.02560	3.61653
20.....	1.48595	1.63862	1.80611	2.19112	2.65330	3.20714	3.86968
21.....	1.51567	1.67958	1.86029	2.27877	2.78596	3.39956	4.14056
22.....	1.54598	1.72157	1.91610	2.36992	2.92526	3.60354	4.43040
23.....	1.57690	1.76461	1.97359	2.46472	3.07152	3.81975	4.74053
24.....	1.60844	1.80873	2.03279	2.56330	3.22510	4.04893	5.07237
25.....	1.64061	1.85394	2.09378	2.66584	3.38635	4.29187	5.42743
26.....	1.67342	1.90029	2.15659	3.77247	3.55567	4.54938	5.80735
27.....	1.70689	1.94780	2.22129	2.88337	3.73346	4.82235	6.21387
28.....	1.74102	1.99650	2.28793	2.99870	3.92013	5.11169	6.64884
29.....	1.77584	2.04641	2.35657	3.11865	4.11614	5.41839	7.11426
30.....	1.81136	2.09757	2.42726	3.24340	4.32194	5.74349	7.61226
31.....	1.84759	2.15001	2.50008	3.37313	4.53804	6.08810	8.14511
32.....	1.88454	2.20376	2.57508	3.50806	4.76494	6.45339	8.71527
33.....	1.92223	2.25885	2.65234	3.64838	5.00319	6.84059	9.32534
34.....	1.96068	2.31532	2.73191	3.79432	5.25335	7.25103	9.97811
35.....	1.99989	2.37320	2.81386	3.94609	5.51601	7.68609	10.67658
36.....	2.03989	2.43253	2.89828	4.10393	5.79182	8.14725	11.42394
37.....	2.08068	2.49335	2.98523	4.26809	6.08141	8.63609	12.22362
38.....	2.12230	2.55568	3.07478	4.43881	6.38548	9.15425	13.07927
39.....	2.16474	2.61957	3.16702	4.61637	6.70475	9.70351	13.99482
40.....	2.20804	2.68506	3.26204	4.80102	7.03999	10.28572	14.97446
41.....	2.25220	2.75219	3.35990	4.99306	7.39199	10.90286	16.02268
42.....	2.29724	2.82100	3.46069	5.19278	7.76159	11.55704	17.14426
43.....	2.34319	2.89152	3.56451	5.40050	8.14967	12.25046	18.34436
44.....	2.39005	2.96381	3.67145	5.61652	8.55715	12.98548	19.62846
45.....	2.43785	3.03790	3.78159	5.84118	8.98501	13.76461	21.00245

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